

FINAL
ENVIRONMENTAL ASSESSMENT

Evaluation of Prescribed Burning

for Ecological Restoration and Forest Management



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Prepared for
Department of The Air Force
Arnold Air Force Base, Tennessee

CH2MHILL

January 2005

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Finding of No Significant Impact:

Arnold Air Force Base, Tennessee

Prescribed Burning for Ecological Restoration and Forest Management

Arnold Air Force Base (Arnold AFB) has prepared an Environmental Assessment (EA) (January 2005) that evaluates the potential environmental and socioeconomic impacts associated with implementation of the Prescribed Burning Program.

Description of the Proposed Action

The Proposed Action is to implement the Prescribed Burning Program and wildfire management policy to support the Integrated Ecosystem Management Plan, Forest Management Plan, Eggert's Sunflower Management Plan, and Barrens Management Plan.

The objectives of the Proposed Action are to:

- Control forest fuel levels and promote habitat development
- Maintain fire breaks
- Protect soils from erosion

The Prescribed Burning Program is a necessary component of ecosystem and forest management on Arnold AFB. Prescribed burning is conducted in pine forests to maintain low forest fuel levels and to minimize forest resource damage in the event of a wildfire. Selected hardwood forests are burned to promote more open grassland or savanna habitat as part of the restoration of the Barrens mosaic on Arnold AFB. Established open areas within the Barrens mosaic also are burned to maintain habitat conditions. The Barrens mosaic is an important natural resource both regionally and on Arnold AFB. Habitat of the Eggert's sunflower, a federally listed threatened species that occurs on Arnold AFB, requires prescribed burning to promote habitat conditions, as specified in the Barrens Management Plan and the Cooperative Management Agreement (CMA) between the US Fish and Wildlife Service (USFWS) and Arnold AFB.

The EA examined the potential for impacts to the environment that would result from implementation of the prescribed burning management methods across the landscape at Arnold AFB. Arnold AFB identified target areas that require prescribed burning on a regular basis. The current plan addressed specific actions that would be implemented during fiscal years 2005 and 2006, including:

- Prescribed burns on 1,100 acres of pine forests in 2005 and 1,100 acres in 2006
- Prescribed burns on 741 acres of Barrens mosaic restoration sites in 2005 and 1,588 acres in 2006
- Prescribed burns on 64 acres of Eggert's sunflower habitat in 2005 and 181 acres in 2006

No-Action Alternative

Under the No-Action Alternative, no prescribed burning would be implemented on Arnold AFB. Wildfire fuel would build up and the potential for wildfires would substantially increase. In the absence of prescribed burning, Barrens mosaic and Eggert's sunflower habitat would recede. In the case of the Eggert's sunflower, this would have a significant impact on the species. In the case of the Barrens mosaic, the amount of habitat would decrease. Without the prescribed burning, the conservation objectives would not be achieved and terms of the CMA would not be met. As a result, the No-Action Alternative does not meet the stated objectives.

Environmental Consequences

No significant negative environmental or socioeconomic consequences were identified in the EA for the proposed project. Use of prescribed burning presents an occupational health risk to the individuals involved in the activity. A prescribed burning plan would be developed for each burn event. The plan would outline safety procedures and identify the conditions (weather and fuel moisture content) for conducting the burn. A job safety analysis (JSA) has been developed for the prescribed burning operations. Personnel participating in each event must read, understand, and sign the JSA before participating in the burn. Operations would be conducted according to prescribed burning procedures and the public would be protected from exposure to harmful conditions.

Conclusion

The attached EA was prepared pursuant to 32 Code of Federal Regulations (CFR) 989 and U.S. Council on Environmental Quality (CEQ) regulations (Title 40, U.S. Code, Parts 1500-1508) for implementing the procedural requirements of the National Environmental Policy Act (NEPA). The finding of this EA is that the Proposed Action will have no significant impact on the human or natural environment. Notification was provided in local newspapers from 9-Feb-2005 through 11-Mar-2005 with no response from the public. Therefore, a Finding of No Significant Impact (FONSI) is issued for the Proposed Action and no Environmental Impact Statement (EIS) is required.

Restrictions

No restrictions are necessary for the Proposed Action.



Charles H. King
Chief, Environmental Management Division
Arnold AFB, TN

Date: 24 Mar 05

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Acronyms and Abbreviations

AEDC	Arnold Engineering Development Center
AF	Air Force
AFB	Air Force Base
AFMC	Air Force Materiel Command
AFI	Air Force Instruction
AICUZ	Air Installation Compatible Use Zone
ATSDR	Agency for Toxic Substances and Disease Registry
BMP	Best Management Practice
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMA	Cooperative Management Agreement
CO	Carbon Monoxide
CWA	Clean Water Act
DoD	Department of Defense
EA	Environmental Assessment
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
FMP	Fire Management Plan
FMU	Fire Management Unit
ft	Feet
FY	Fiscal Year
g/kg	Grams per Kilogram
IEMP	Integrated Ecosystem Management Plan

IPT	Integrated Process Team
JSA	Job Safety Analysis
LCES	Lookouts, Communications, Escape Routes, Safety Zones
Mg	Megagram
MU	Management Unit
NCGP	No Consumption-General Public
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	Non-point Source
NRHP	National Register of Historic Places
NWS	National Weather Service
PAH	Polycyclic Aromatic Hydrocarbon
PBP	Prescribed Burn Plan
PCB	Polychlorinated Biphenyl
PM ₁₀	Particulate Matter Less Than or Equal to 10 Microns in Aerodynamic Diameter
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROW	Right-of-Way
RTE	Rare, Threatened, and Endangered
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SMZ	Streamside Management Zone
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment and Conservation
tpy	Tons per Year

TSCA	Toxic Substances Control Act
TVA	Tennessee Valley Authority
TWQCA	Tennessee Water Quality Control Act
TWRA	Tennessee Wildlife Resources Agency
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USC	U.S. Code
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WQA	Water Quality Act

1.0 Purpose and Need for Action

1.1 Background

Arnold Air Force Base (AFB) is located in Coffee and Franklin Counties in Middle Tennessee. Arnold AFB is approximately 70 miles southeast of Nashville, the state capitol. Positioned near the towns of Manchester, Tullahoma, and Winchester, Arnold AFB is the largest employer in the two-county area (Figure 1-1).

Arnold AFB occupies 39,081 acres including the 3,632-acre Woods Reservoir, which contains approximately 26 billion gallons of water. Woods Reservoir is the source of drinking water for the Base and provides cooling water for facilities in the industrial area. On Arnold AFB, there are 5,647 acres of cultivated pine forests and 23,816 acres of hardwood forests. Grasslands and early-successional habitats found in utility rights-of-way (ROWs) occupy 1,479 acres on the installation and provide habitat for numerous rare species.

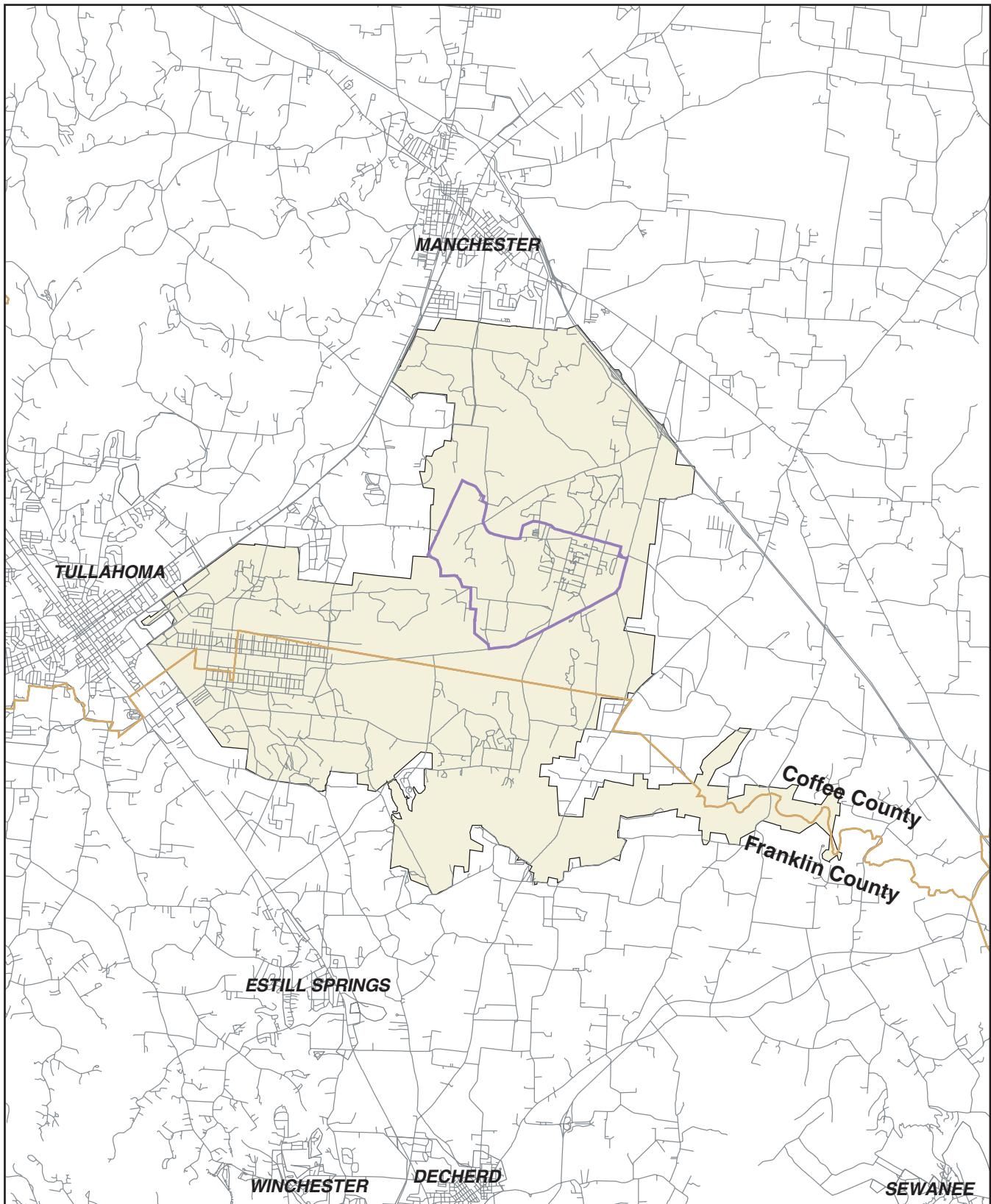
1.1.1 Operations

Arnold Engineering Development Center (AEDC), which is located on Arnold AFB, is the most advanced and largest complex of flight simulation test facilities in the world, with 53 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges, and other specialized units. Facilities can simulate flight conditions from sea level to altitudes of more than 100,000 feet (ft), and from subsonic velocities to those well over Mach 20. Twenty-seven of AEDC's test units have capabilities unmatched in the world. AEDC has contributed to the development of nearly every top national aerospace program since the 1950s. Customers include the U.S. Air Force (AF), the Army and Navy, the National Aeronautics and Space Administration, the Federal Aviation Administration, private industry, allied foreign governments, and U.S. government and educational institutions.

The Arnold AFB commander is responsible for accomplishing the Base's mission. The commander's staff of military personnel and civil service employees is responsible for the overall planning, direction, scheduling, assignment, and funding associated with mission requirements. Under staff supervision, the management, operation, and maintenance of test facilities, real property, and related equipment and utilities are accomplished by contract.

1.1.2 History

Arnold AFB is named for the late Henry H. "Hap" Arnold. At the close of WW II, General Arnold, Commander of the Army Air Forces, asked Dr. Theodore von Karman,



0 1.25 2.5 Miles
N



LEGEND

— Road Centerline	■ AEDC Boundary	■ Arnold AFB Boundary
— County Boundaries		

Figure 1-1
Arnold Air Force Base and General Vicinity
 Prescribed Burn
 Final Environmental Assessment

Chief Scientific Advisor to the AF and one of history's great aeronautical test scientists, to form a Scientific Advisory Group to chart a long-range research and development course for the future AF. Dr. von Karman sent a task force from his newly formed group to Germany to determine how the Germans had made such rapid progress in developing high-performance jet aircraft and rocket-powered missiles. One member of the task force, Dr. Frank Wattendorf, was responsible for surveying wind tunnels and ground test facilities. On his flight home, Dr. Wattendorf wrote a memo that proposed using captured German test facilities to establish a new engineering development center. The new center would consolidate the best civilian and military scientists as well as state-of-the-art test facilities to properly test and evaluate the weapon systems needed to guarantee the United States' superior airpower and thereby the national security. Dr. Wattendorf's "trans-Atlantic memo" became the blueprint for AEDC.

In 1949, Congress authorized \$100 million for the construction of AEDC. A site was selected for the new center at the Army's old Camp Forrest near Tullahoma, and construction began in June 1950. The site was chosen because of the availability of land, water, and power, and to buffer surrounding communities from expected test hazards and noise. Water was needed to cool the rapidly flowing air and hot exhaust gases, and electricity was required to power the huge motordrive systems. The large land acquisition was necessary to accommodate growth for future test facilities and its remote location provided the security required by the size of the installation.

On 25 June 1951, 1 year after General Arnold's death, President Harry S Truman dedicated the AEDC and renamed it in honor of General Arnold. Anticipating the role this national facility would play in developing key weapon systems, President Truman said, "Never again will the United States ride the coattails of other countries in the progress and development of the aeronautical art. The genius that was General Arnold's is manifest in this installation, which now bears his name."

1.1.3 Military Mission

The military mission is to support the development of aerospace systems by testing hardware in facilities that simulate flight conditions. The AEDC also conducts a research and technology program to develop advanced test techniques and instrumentation and to support the design of new test facilities. The official mission is:

To provide our customers with the world's most effective and affordable aerospace ground test and evaluation, and simulation products and services. To ensure AEDC ground test facilities, technologies, and knowledge fully support today's and tomorrow's customers.

Implicit within this mission is the need to anticipate and plan for growth of the test facilities at AEDC. Ecosystem management provides the framework for the careful assessment of environmental impacts, allowing for the planning and development of new facilities, while at the same time protecting the natural and cultural resources.

The implementation of ecosystem management at Arnold AFB is also in direct support of the overall Department of Defense (DoD) mission. The DoD mission requires that natural resources be managed to provide for the environmental security necessary to

support the military mission of national defense. By conserving biodiversity, ecosystem management contributes to national security by helping maintain the natural resources upon which this country's strength depends. Ecosystem management also helps maintain natural landscapes for military training. Combat readiness is founded on the ability of the armed forces to sustain realistic military training now and into the future.

1.2 Proposed Action

Arnold AFB lies within the eastern Highland Rim. Historically the eastern Highland Rim was characterized by a Barrens mosaic that included grassy openings. Arnold AFB retains the remnants of the Barrens mosaic. Fire influenced the species composition and development of the Barrens habitat (Strohmeier, 2003a). However, fire suppression over a 50-year period resulted in habitat changes in forested areas. Only a few native grasslands still exist. The once-common open-canopy woodlands and savannas with diverse herbaceous understory vegetation are rare. Arnold AFB represents the best opportunity in the region to restore a functional Barrens ecosystem.

Management of pine and hardwood forests on Arnold AFB is required to minimize the potential for wildfire, maintain the Barrens mosaic habitat, and preserve habitat for the Eggert's sunflower (*Helianthus eggertii*). Prescribed burning is a management tool that is very effective for controlling the litter and understory growth that occur in these habitats. The Proposed Action is to conduct prescribed burning for ecological restoration and forest management on Arnold AFB as described in Arnold AFB's Fire Management Plan (Strohmeier, 2003b). Three objectives of the prescribed burning program are to:

- Control fuel and promote habitat development
- Maintain firebreaks
- Protect soil from erosion

Pine forests on Arnold AFB are burned on 3- to 5-year cycles to reduce fuel loads, eliminate undesirable vegetation, and improve wildlife habitat. Approximately 1,100 acres of pines are burned each year. Selected hardwood forests are burned to promote more open grassland or savanna habitat as part of the restoration of the Barrens mosaic on Arnold AFB. Established open areas within the Barrens mosaic also are burned to maintain habitat conditions. Management of Eggert's sunflower, a federally listed threatened species that occurs on Arnold AFB, includes prescribed burning to promote habitat conditions, as specified in the Barrens Management Plan and the Cooperative Management Agreement (CMA) between the US Fish and Wildlife Service (USFWS) and Arnold AFB.

1.3 Need for Proposed Action

The prescribed burning program is an important tool for conservation planning and habitat restoration at Arnold AFB. Prescribed burning is a necessary component of ecosystem and forest management and accomplishes several functions. For example, prescribed burning is conducted in pine forests to maintain low forest fuel levels and to

prevent forest resource damage in the event of a wildfire. Prescribed burning is also conducted to control understory growth and maintain open grassy areas.

An area may be burned to regulate fuel loads and reduce the likelihood of wildfire, to control weeds, to release nutrients, to aid tree regeneration, and/or to generate desired changes in native vegetation composition.

Fuel consists of both living and dead vegetation, including the litter and duff soil horizons, that can be ignited and support a fire (Brown, 2000). Fuel also may include organic soils, such as wetland soils, under certain conditions. Fire is governed primarily by five characteristics of the fuel:

- Total fuel
- Fuel load
- Fuel availability
- Fuel continuity
- Fuel moisture content

Total fuel is the amount of biomass that potentially could burn. "Fuel load" refers to the amount of flammable material within a given area, typically expressed as mass per unit area. "Fuel availability" refers to the portion of the fuel load that will burn under a given set of conditions (temperature, humidity, continuity, moisture content). Fuel continuity is a measure of the horizontal and vertical distribution of fuel components. When continuity is high, fires readily spread. With low fuel continuity, a more intense fire is required to generate fire-spread. Fuel moisture content is a measure of the amount of moisture, measured as dry weight fraction, in fuel. It is considered the most important fuel property in controlling flammability. Live vegetation typically has more than 80 percent fuel moisture, while the percentage in dead vegetation is dependent on temperature, humidity, recent precipitation, and time elapsed since death of the plant.

Implementing prescribed burns on approximately 1,100 acres each year maintains a 3- to 5-year burn cycle on Arnold AFB in pine forests, which is necessary to maintain desirable low fuel loading and promote desired development of the pine management units (MUs).

The Barrens mosaic is an important natural resource both regionally and on Arnold AFB. It is a focal point of the site conservation planning process, as described in the Integrated Ecosystem Management Plan (IEMP) for Arnold AFB (Call, 2003). Fire is a useful management tool for maintaining the Barrens mosaic. A Barrens Management Plan has been developed for the Barrens mosaic on Arnold AFB (Strohmeier, 2003a). This plan directs the use of prescribed burns and other management tools for ecological restoration during the period from Fiscal Year (FY) 2003 through FY 2008.

The CMA established in June 2004 to manage the Eggert's sunflower through the management of Barrens habitat is described in the 2004 Arnold AFB Barrens Management Plan. This plan recommends prescribed burning on approximately 240 acres on Arnold AFB to support recovery goals established by USFWS for the species. Arnold AFB has adopted a wildfire management policy that is necessary to provide protection and safety for Arnold AFB employees and visitors. The wildfire

management policy also allows Arnold AFB to fulfill its mission requirements while using wildfire as a tool for resource management.

1.4 Objectives of Proposed Action

The main objective of the Proposed Action is to maintain, enhance, and/or restore the ecological balance and diversity of Arnold AFB lands specifically by improving habitats for game and rare, threatened, and endangered (RTE) species of plants and wildlife. The prescribed burn program is consistent with, and helps to achieve the goals of, integrated ecosystem management on Arnold AFB.

1.5 Related Environmental Documents

The following documents were used in the preparation of this Environmental Assessment (EA):

Two-Year Conservation Management Plan 2005-2006, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by ATA Conservation.

Two-Year Forest Management Plan 2005-2006, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by ATA Conservation.

Arnold Air Force Base Fire Management Plan (FMP) 2003, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by Clint Strohmeier, Restoration Ecologist, ACS Environmental Services, Conservation.

Barrens Management Plan Annual Update 2003, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by Clint Strohmeier, Restoration Ecologist, ACS Environmental Services, Conservation.

Integrated Ecosystem Management Plan 2003, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by Geoff Call, Restoration Ecologist, ACS Environmental Services, Conservation.

1.6 Decision to Be Made

A decision is required regarding the impacts of conducting prescribed burning activities within the framework of the Arnold AFB IEMP, FMP, and Barrens Management Plan.

1.7 Applicable Regulatory Requirements, Permits, and Coordination

The following regulations, permits, or coordination may be applicable to an action alternative as described in this EA:

- The National Environmental Policy Act (NEPA) of 1969
- Title 40 of the Code of Federal Regulations (CFR), Parts 1500-1508 (40 CFR 1500-1508)
- DoD Directive 6050.1 (32 CFR 214)
- Air Force Instruction (AFI) 32-7061
- AFI 32-7064
- Executive Order (EO) 11514, Protection and Enhancement of Environmental Quality (amended by EO 11991)
- The Endangered Species Act (ESA) of 1973 (16 U.S. Code [USC] 1531-1543),
- The Fish and Wildlife Coordination Act, (16 USC 661, et seq.),
- The Migratory Bird Treaty Act (16 USC 701, et seq.)
- The Clean Water Act (CWA) of 1977 and the Water Quality Act (WQA) of 1987 (33 USC 1251 et seq., as amended)
- EO 11990, Protection of Wetlands
- EO 12372, Intergovernmental Review of Federal Programs
- The Farmland Protection Act of 1981 (7 USC 4201 et. seq., as amended)
- DoD 4165.57, Air Installation Compatible Use Zone (AICUZ)
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (as amended by the Superfund Amendments and Reauthorization Act [SARA] of 1986)
- The Resource Conservation and Recovery Act (RCRA) of 1976
- The Toxic Substances Control Act (TSCA)
- The National Historic Preservation Act (NHPA) of 1966 (16 USC 470 et seq., as amended)
- The Protection of Historic Properties (36 CFR 800) Act
- The Archeological Resources Protection Act of 1979
- The CWA of 1977 and the WQA of 1987
- EO 11988, Floodplain Management
- The Clean Air Act (CAA) (42 USC 7401 et seq., as amended)
- The Noise Control Act of 1972
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations

- EO 13045, Protection of Children from Environmental Health Risks and Safety Risk

1.8 Authority and Scope of the Environmental Assessment

This document was prepared in accordance with the requirements of the NEPA of 1969, the Council on Environmental Quality (CEQ) regulations of 1978, and 32 CFR Part 989. To initiate the environmental analysis, the proponent (Arnold AFB) submitted an AF Form 813 – Request for Environmental Impact Analysis (Appendix A).

1.8.1 Issues Eliminated from Detailed Analysis

The Proposed Action would not have the potential for significant impacts to several resource areas on Arnold AFB. Consequently, the resource areas discussed below have been eliminated from analysis in this document.

1.8.1.1 Land Use

The Proposed Action would be consistent with the IEMP, FMP, and Barrens Management Plan. The Proposed Action would not result in changes in land use. Limited construction and maintenance of firebreaks may be necessary but would not result in substantial land use changes.

1.8.1.2 Noise

The Proposed Action would require limited use of heavy equipment for firebreak construction and maintenance. The use of this equipment would generate noise. Work would occur during regular working hours and workers would wear proper hearing protection. The noise from firebreak construction would be temporary. Other than workers, there are no potential sensitive receptors for the noise from firebreak construction and maintenance. Therefore, noise was eliminated as an issue warranting further analysis.

1.8.1.3 Geology

No activities conducted under the Proposed Action would affect the underlying geologic features of Arnold AFB.

1.8.1.4 Socioeconomic Factors

The Proposed Action would have no significant effect on socioeconomic factors. There would be no increase or loss in permanent staffing positions on Arnold AFB, nor would there be any gain or loss of permanent employment in the surrounding region. The prescribed burn areas are on Arnold AFB and the Proposed Action would not impact minority or low income population groups. There would be no change in demand for recreational facilities/opportunities and no change in recreational facilities/opportunities available to the staff of Arnold AFB or residents of the region. The prescribed burn program would not cause people to move into or out of the area. With no change in population, the Proposed Action would not result in a change in demand for community infrastructure and services (fire, police, medical, housing, schools, etc.). Therefore, socioeconomic factors were eliminated as issues warranting further analysis.

1.8.2 Issues Studied in Detail

The issues studied in detail are:

- Safety and Occupational Health
- Airfield Management and Airfield Operation
- Air Quality
- Geomorphology
- Water Quality
- Biological Resources
- Cultural Resources
- Environmental Restoration Program
- Cumulative Impacts

1.9 Document Organization

This EA follows the organization established by the CEQ regulations (40 CFR, Parts 1/500-1508). This document consists of the following sections:

- 1.0 Purpose and Need for Action
- 2.0 Description of the Proposed Action and Alternatives
- 3.0 Affected Environment
- 4.0 Environmental Consequences
- 5.0 Plan, Permit, and Management Requirements
- 6.0 List of Preparers
- 7.0 List of Contacts
- 8.0 References
- Appendices

2.0 Description of Proposed Action and Alternatives

As required by federal regulation, this EA reviews the issues and addresses the potential environmental impacts of the Proposed Action and the No-Action Alternative.

2.1 Proposed Action (Preferred Alternative)

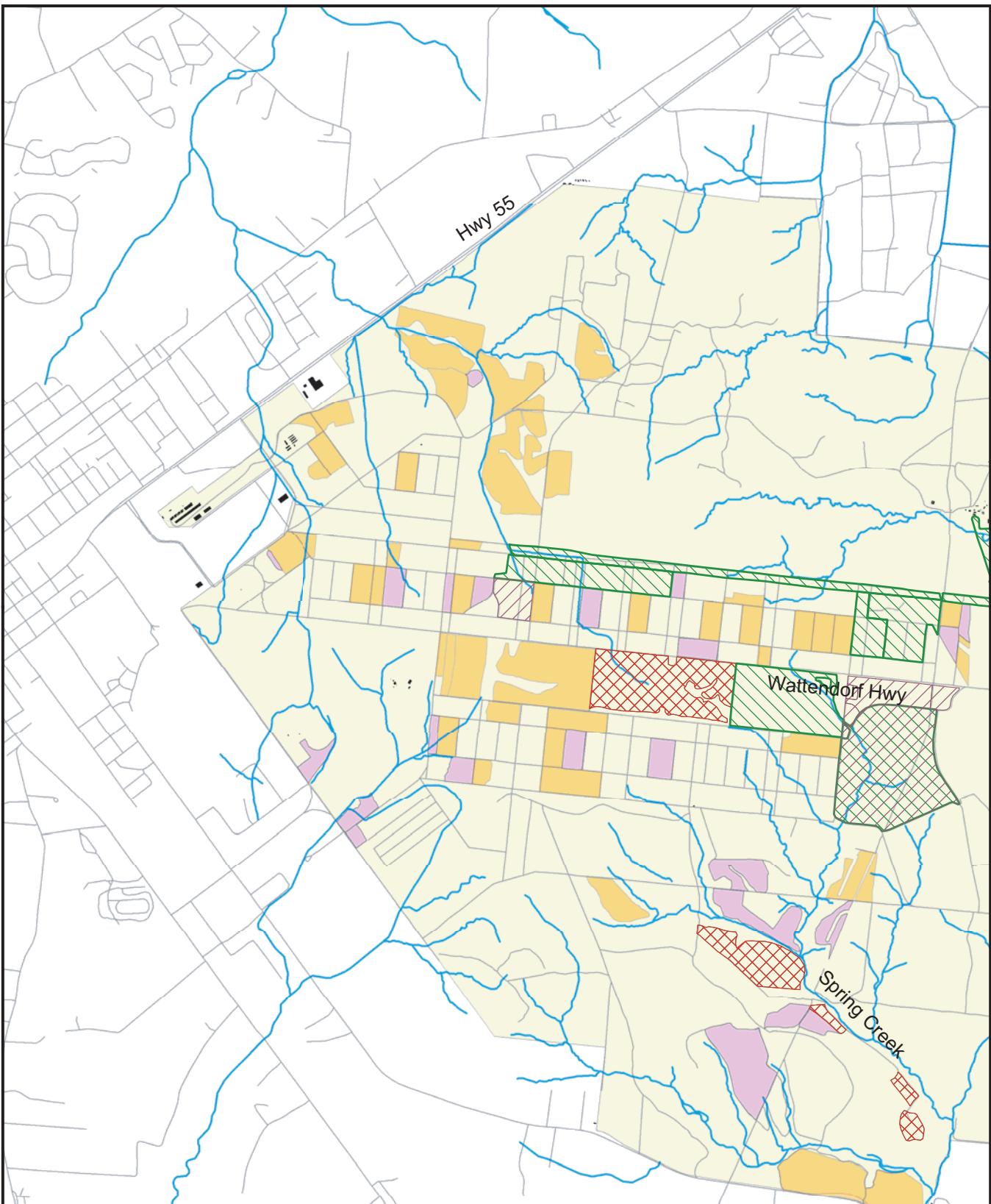
The Proposed Action is to implement the prescribed burn program and wildfire management policy to support the IEMP, FMP, and Barrens Management Plan on Arnold AFB. To accomplish the Proposed Action would require maintaining firebreaks, conducting prescribed burning, and protecting the sites to reduce/eliminate soil erosion.

In the Proposed Action, prescribed burns would also be conducted on approximately 1,100 acres of pine forest, 741 acres of Barrens mosaic restoration sites, and 64 acres of Eggert's sunflower habitat in FY 2005 (Figures 2-1 through 2-3). Approximately 1,100 acres of pine forest, 1,588 acres of Barrens mosaic restoration sites, and 181 acres of Eggert's sunflower habitat would be burned in FY 2006 (Figures 2-1 through 2-3).

Firebreak maintenance in FY 2005 would be conducted on 20 sites covering 15 miles of firebreak. In FY 2006, firebreak maintenance would be accomplished on 26 miles at 40 sites. Firebreak maintenance would require removal of debris by hand, removal of light brush with a chainsaw, removal of heavy vegetation or debris with a bulldozer, and replacement of graded material after the prescribed burn is complete.

The wildfire management program divides Arnold AFB into three Fire Management Units (FMUs). FMU-1 includes the AEDC Industrial Area and the land surrounding Woods Reservoir and covers approximately 5,229 acres, excluding Woods Reservoir (Figure 2-4). FMU-2 comprises approximately 24,683 acres and includes the areas south of Wattendorf Highway and north of North Shore and Brick Church Roads, all of the Camp Forrest area, areas south of Dixie Road and north of the industrial area, and land north of Arnold airfield. FMU-3 encompasses approximately 5,462 acres and includes the lands north of Dixie Road, east of Hills Chapel Road, up to Huckleberry Creek and Hunts Creek Roads. It also includes a portion of the Tennessee Army National Guard Training Area.

FMUs are land management areas definable by objectives, topographic features, access, resources to be protected, political boundaries, and/or fuel types that distinguish them from management characteristics of adjacent units. Management objectives and strategies selected to accomplish these objectives have been developed for each FMU on Arnold AFB to guide wildfire management responses and prescribed burn operations to prevent undesirable consequences.



0 1,250 2,500 Feet

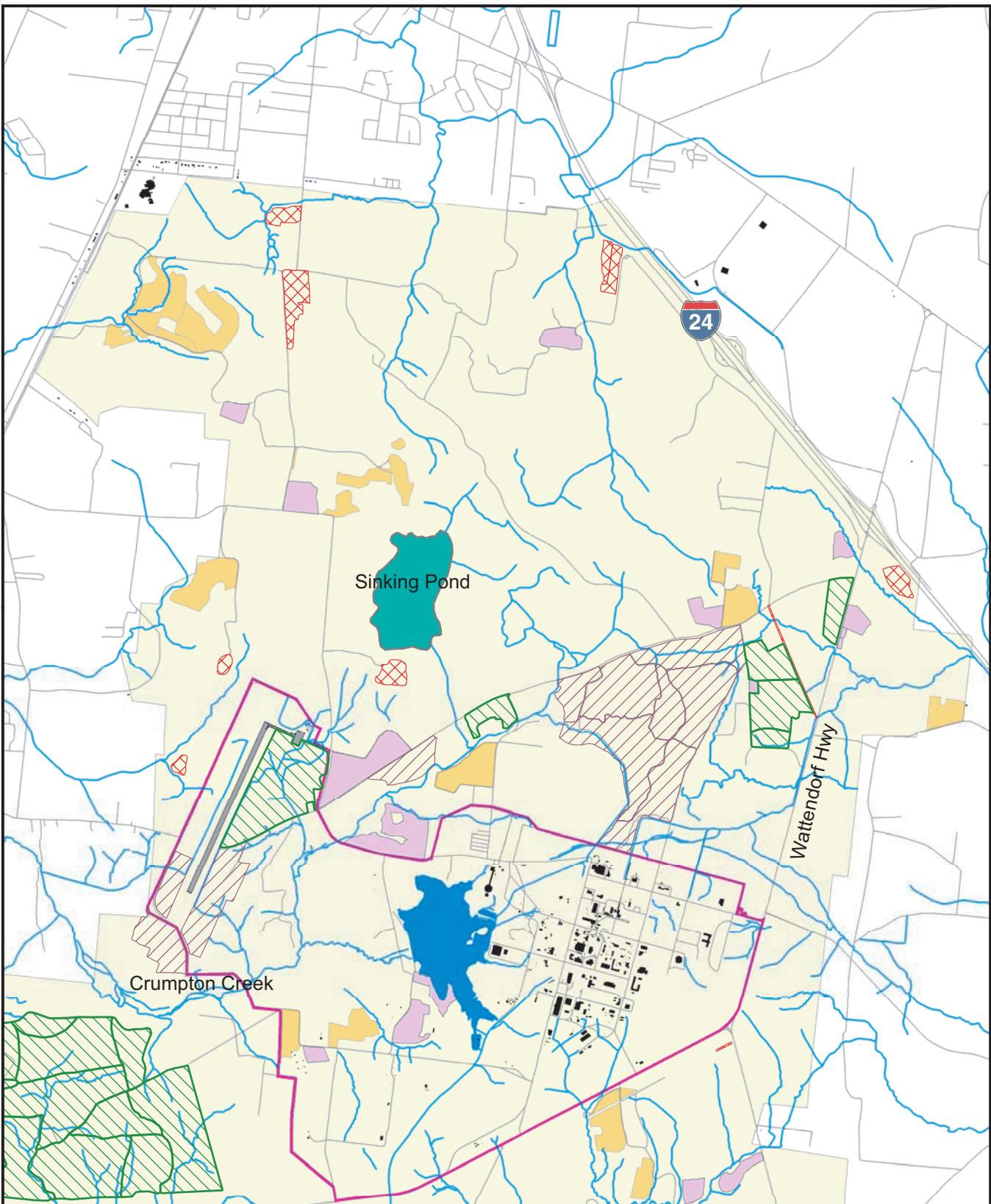
- Proposed Burn 06
- Proposed Burn 05
- ☒ TWRA Burn 05-06
- ▨ Barrens Restoration Burn 06
- ▨ Barrens Restoration Burn 05

N

- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- Arnold AFB Boundary



Figure 2-1
2005-2006 Prescribed Burns - Western
Prescribed Burn
Final Environmental Assessment

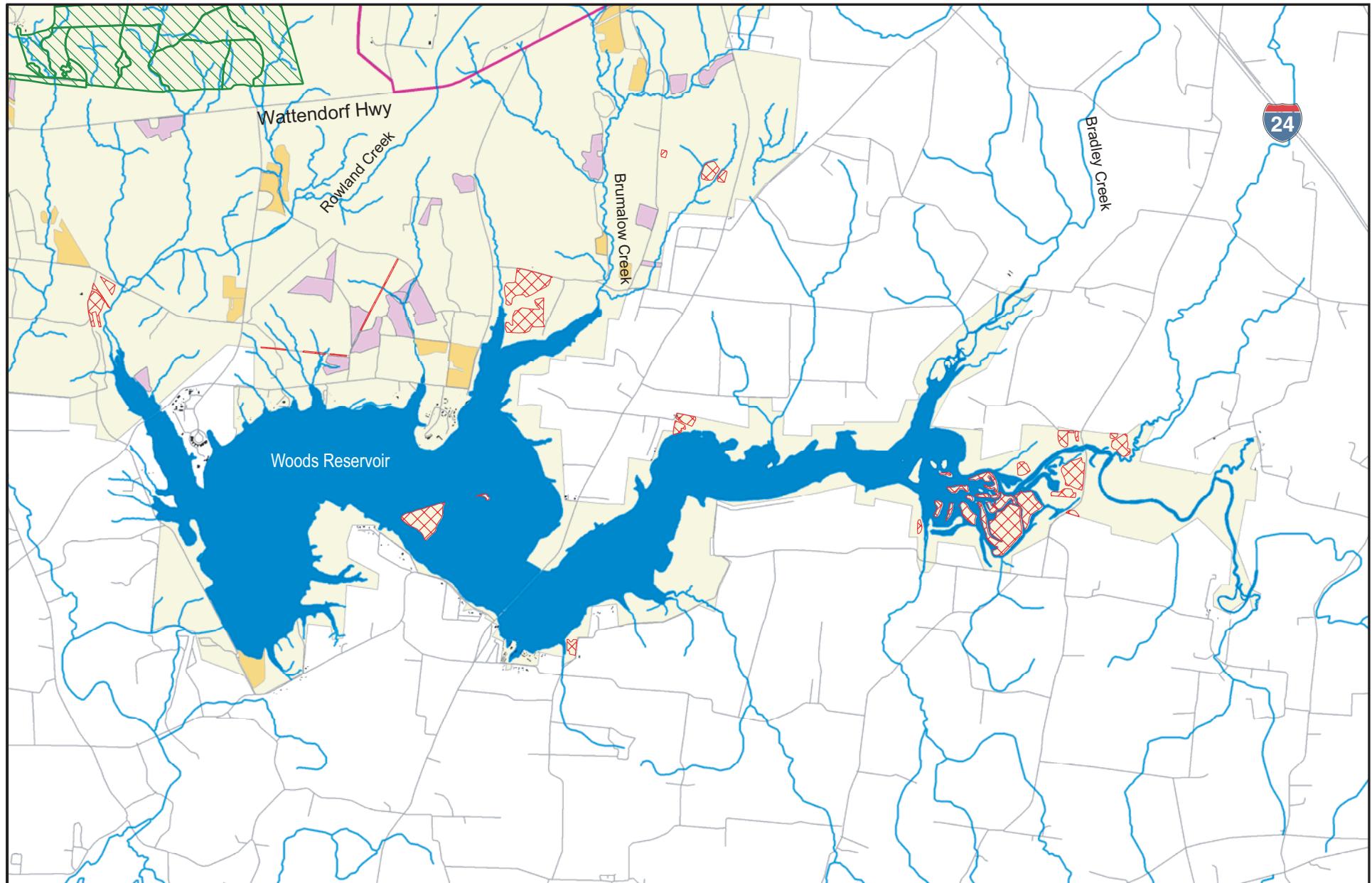


0 1,250 2,500 Feet

Streams
Road Centerline
Buildings
X TWRA Burn 05-06
Barrens Restoration Burn 06
Barrens Restoration Burn 05
N



Figure 2-2
2005-2006 Prescribed Burns - Northern
Prescribed Burn
Final Environmental Assessment

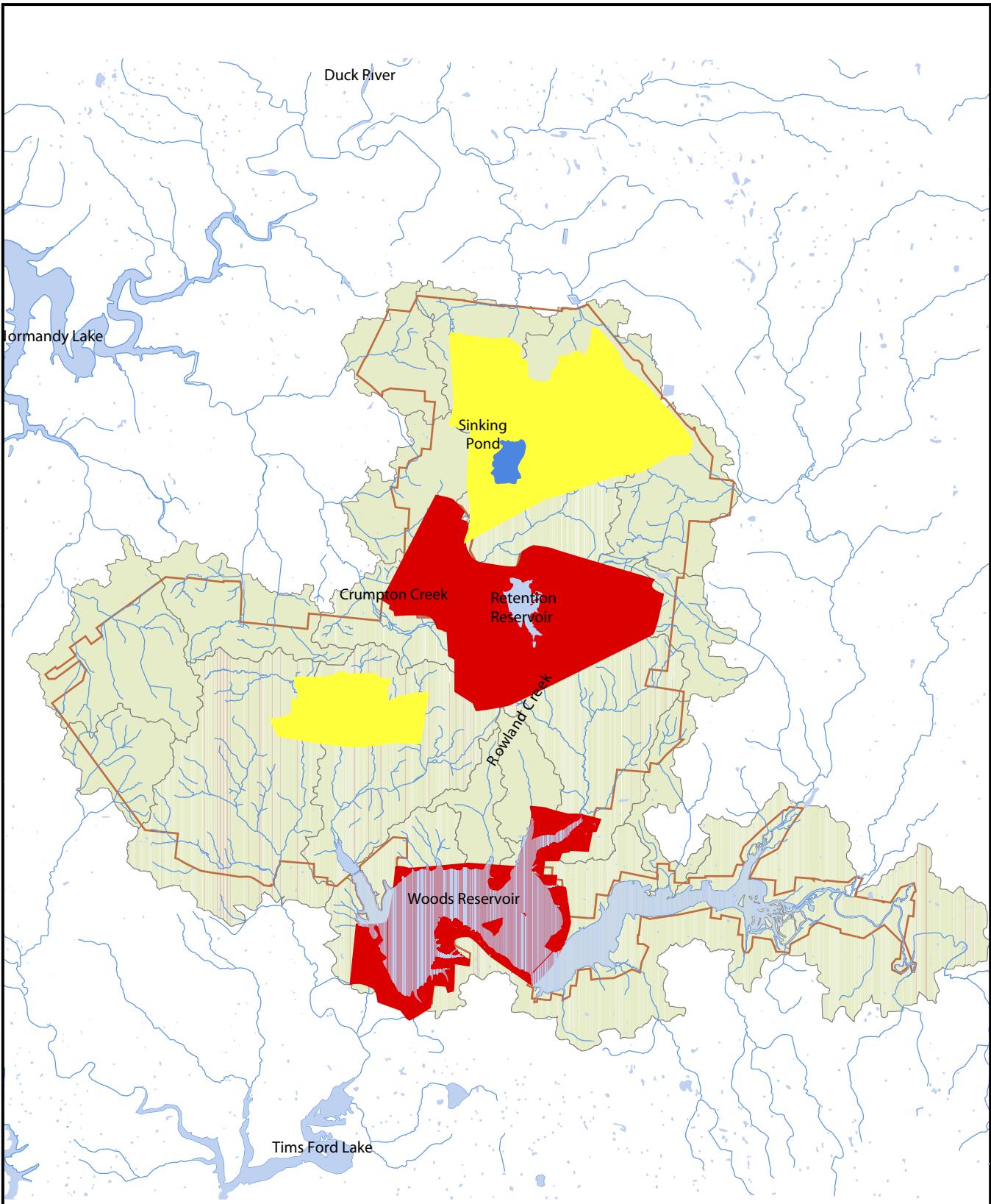


Proposed Burn 06	Streams
Proposed Burn 05	Road Centerline
AEDC Boundary	Buildings
TWRA Burn 05-06	Reservoirs
Barrens Restoration Burn 06	Arnold AFB Boundary
Barrens Restoration Burn 05	

0 1,250 2,500
Feet



Figure 2-3
2005-2006 Prescribed Burns - Eastern
Prescribed Burn
Final Environmental Assessment



Legend

Fire Management Units

- Unit 1
- Unit 2
- Unit 3



Figure 2-4
Arnold Air Force Base Fire Management Units
Prescribed Burn
Final Environmental Assessment

The objectives and strategies for wildfire suppression and prescribed burns for each FMU are presented in Appendix B. Fire management strategies are adaptable to allow for exceptions and modifications should the need arise. The intent is to allow for extensive fires to occur in selected FMUs, regardless of cause, while recognizing that situations could arise that require wildfires to be immediately suppressed in those FMUs. The AEDC Fire Department, in conjunction with Conservation, makes decisions regarding individual wildfire events (or escaped prescribed burns) as they occur.

Monitoring consists of observing and collecting data on wildfire, smoke behavior, fuel types, and terrain present within the potential burn areas. Current weather data and weather forecasts are also monitored. This information is used to predict fire size, progression, and behavior through time, allowing firefighters to determine whether a fire will safely burn out or if direct intervention will be necessary.

The preferred alternative is the Proposed Action, as described above. The Proposed Action would fulfill the goals of the FMP and meet the overall objectives for natural resource management on Arnold AFB.

2.2 No-Action Alternative

The No-Action Alternative would be not to conduct prescribed burns and have no wildfire suppression policy. Under this alternative, the goals of the IEMP would not be met. In addition, the No-Action Alternative would not result in an enhanced environment for sensitive species, such as Eggert's sunflower. As a result, the No-Action Alternative does not meet the stated main objective.

2.3 Alternatives Considered but Not Carried Forward

NEPA requires that the Proposed Action, No-Action Alternative, and any other practicable alternatives be considered in the analysis. As discussed above, under the need for the project, the FMP was developed to implement measures defined in the IEMP. The overriding objective is to conduct sustainable forestry activities that contribute to the conservation of healthy, functioning ecosystems at Arnold AFB.

The proposed burn schedule for a given fiscal year is determined through long-range planning. This schedule is developed by Conservation staff using a regularly updated inventory of MU conditions and conservation needs. These plans are developed with input from the members of the Conservation Integrated Process Team (IPT).

As part of the resource conservation process at Arnold AFB, an interdisciplinary team of experts has been established to review existing and proposed management actions for their impacts. The members include:

- AEDC
- Tennessee Army National Guard
- Tennessee Department of Agriculture (TDA), Division of Forestry

- Tennessee Department of Environment and Conservation (TDEC), Division of Natural Heritage
- Tennessee Wildlife Resources Agency (TWRA)
- USFWS
- United States Geological Survey (USGS)
- Middle Tennessee State University
- The Nature Conservancy
- The University of the South
- The University of Tennessee

Potential prescribed burn alternatives that would not have been developed through this integrated process are not considered practicable for achieving the forest and ecosystem management goals of Arnold AFB. Therefore, no other action alternatives are considered in this analysis.

2.4 Comparison of Alternatives

The Proposed Action and the No-Action Alternative are compared in Table 2-1.

TABLE 2-1
Comparison of Impacts of Proposed Action and No-Action Alternative
Prescribed Burn Final Environmental Assessment

Resource Area	Proposed Action	No-Action Alternative
Safety and Occupational Health	Potential impacts would be associated with large fires and heavy equipment used to construct firebreaks. Use of Job Safety Analyses (Appendix C), following safety guidelines for all actions, and burning only under proper weather and fuel moisture conditions, would eliminate or minimize the potential for safety risk to Arnold AFB personnel and offbase persons.	Potential for uncontrolled wildfires would increase, as fuel loads would not be managed. These fires could extend offbase, endangering the health and safety of people in the surrounding communities.
Airfield Management and Airfield Operation	Limited periods of smoke generation would occur and could impair airfield operations. Burns near the airfield would be limited to times when weather conditions would not cause smoke to drift across the airfield or when no airfield activity is planned.	The potential for uncontrolled wildfires would increase, leading to more frequent, hotter, and larger fires. These larger fires could impact airfield management and operations through the generation of large plumes of smoke.
Air Quality	Limited periods of smoke generation would occur and could affect air quality in surrounding areas. Burns would be limited to times when weather would not cause accidental drift of smoke into smoke-sensitive areas and into off-base residential areas.	The potential for uncontrolled wildfires would increase, leading to more frequent, hotter, and larger fires. These larger fires could impact air quality by generating large plumes of smoke, particulates, and pollutants.
Geomorphology	Firebreak construction and maintenance has potential for soil compaction and erosion. Soil disturbance would be the minimum necessary to establish or maintain the firebreak. Removed material would be returned following the fire.	No impacts.

TABLE 2-1
 Comparison of Impacts of Proposed Action and No-Action Alternative
Prescribed Burn Final Environmental Assessment

Resource Area	Proposed Action	No-Action Alternative
Water Quality	Non-point source (NPS) pollution could result from firebreak construction and maintenance. Possible NPS pollutants from prescribed burns include sediment, organic matter, ash, and igniter fluids. Soil disturbance would be the minimum necessary to establish or maintain the firebreak. Silt fencing would be used where sufficient vegetated buffer could not be left adjacent to waterways.	The potential for uncontrolled wildfires would increase, leading to more frequent, hotter, and larger fires. These larger fires could impact water quality by causing an increase in the amount of NPS pollution from the associated runoff.
Biological Resources	Biological resources impacts could occur due to injury, mortality, or displacement during burns. Indirect impacts may result from changes in habitat following prescribed burns. Benefit to species assemblage, including sensitive species, associated with Barrens mosaic ecosystem.	Negative impact on habitat for sensitive species (e.g., Eggert's sunflower and species associated with Barrens mosaic) would occur. Large wildfire that would burn away organic soil and cause an undesirable change in vegetation would be more likely to occur.
Cultural Resources	Cultural resources could be subject to fire damage and impacts from firebreak construction and/or maintenance in areas not previously cleared for cultural resources. State Historic Preservation Office (SHPO) consultation and appropriate mitigation would be performed.	No impacts.
Environmental Restoration Program (ERP) and Hazardous Materials	No impacts in Solid Waste Management Unit (SWMU) 98 No impacts; the SWMU 24 incinerator and landfill areas would be avoided.	No impacts.

3.0 Affected Environment

3.1 Occupational Health and Safety

A team has been organized to manage prescribed burns and fight wildfires (Strohmeier, 2003b). The fire boss oversees occupational health and safety impacts associated with the prescribed burn. As the director of the crew working a specific prescribed burn, the fire boss must conduct a pre-burn briefing with all crew members before burn operations begin. The briefing includes the fire safety guidelines and all other aspects of the Prescribed Burn Plan (PBP) (Appendix D) including:

- Objectives of the burn
- Brief burn unit description
- Current weather data and forecast conditions (from National Weather Service [NWS] Fire Weather Forecast and belt weather kits)
- LCES description (Lookouts, Communications, Escape Routes, Safety Zones)
- Location of first aid kits
- Duties assigned to crew members and line bosses (who, what, where)
- Brief description of ignition techniques and other burn operation duties
- Mop-up requirements
- Job Safety Analysis (JSA) description

JSAs (Appendix C) are prepared for all operational activities on the Base. The JSA is a documented process in which all tasks are outlined in a step-wise fashion. Actual or predicted hazards of each step are defined in writing on a job safety analysis worksheet. The required controls and precautions for eliminating or reducing each listed hazard are identified. Each individual must sign the appropriate JSA prior to working on any job. The signature is an acknowledgement that the employee has read and understands the JSA and will implement all applicable controls and precautions.

3.2 Air Installation Compatible Use Zone and Airfield Operation

Arnold AFB has an active airfield and an exemption from Headquarters, Air Force Materiel Command (AFMC) for AICUZ because of the limited number and type of flying operations. The airfield had been inactive and was reactivated in 2000 (Call, 2003). The airfield is used for air training activities, including parachute drop training (CH2M HILL, 2002). Flights at the airfield occur infrequently (Call, 2003.)

3.3 Physical Resources

Physical resources that are addressed include the atmosphere (air quality, climate, and meteorology), geomorphology (landforms, terrain, topography, and soils), and hydrology (surface- and groundwaters, including water quality).

3.3.1 Air Quality

Arnold AFB is located in the Tennessee Valley - Cumberland Mountains Interstate Air Quality Region, which occupies portions of Alabama and Tennessee. Although activities at Arnold AFB result in various sources and volumes of air emissions, the regional air quality is good. Arnold AFB is located in an attainment zone for all pollutants (CH2M HILL, 2002). Air pollutants are emitted from prescribed burning activities and wildfires. TDEC issued AEDC a Title V Operating Permit in May 2002. There are currently 26 emission sources covered under this permit, and all sources are in compliance.

Since Arnold AFB is within an attainment area for all criteria pollutants, major new or modified stationary sources on and in the area of Arnold AFB are subject to Prevention of Significant Deterioration (PSD) review to ensure that these sources are constructed without causing significant deterioration of regional air quality. A major new source is defined as one that has the potential to emit any pollutant regulated under the CAA in amounts equal to or exceeding specific major source thresholds: 100 or 250 tons/year based on the source's industrial category.

Prescribed burning would result in production of combustive emissions, including smoke and associated fine particulate matter. Particulate matter would occur from the felling of trees and grinding of remains, but would be limited to normal working hours. Workers would use proper breathing apparatus, as required, while engaged in the logging activities. Combustive emissions from trucks and logging equipment would be very limited and generally occur in areas where sensitive receptors would not be present.

3.3.2 Geomorphology

The topography at Arnold AFB ranges from relatively flat with poor surface drainage in the northern portion of the installation to moderately rolling with defined stream channels in the southern section. Arnold AFB lies within the eastern part of the eastern Highland Rim physiographic region of Tennessee (Miller, 1974).

The stratigraphic column underlying Arnold AFB consists of fractured carbonate rocks covered by regolith (Wilson, 1976). The regolith is derived from the weathering of the Mississippian-age St. Louis and Warsaw Limestones and ranges from 10 to 100 ft thick at Arnold AFB. Locally, vertical fractures in the bedrock may influence groundwater flow patterns (Haugh and Mahoney, 1994). The lower portion of the Fort Payne bedrock has few fractures and low yields of water (Haugh and Mahoney, 1994). The Chattanooga shale is considered to be the base of the fresh groundwater system in the area (Haugh and Mahoney, 1994; Haugh, 1996). A groundwater divide bisects Arnold AFB and generally corresponds to the surface water drainage divide.

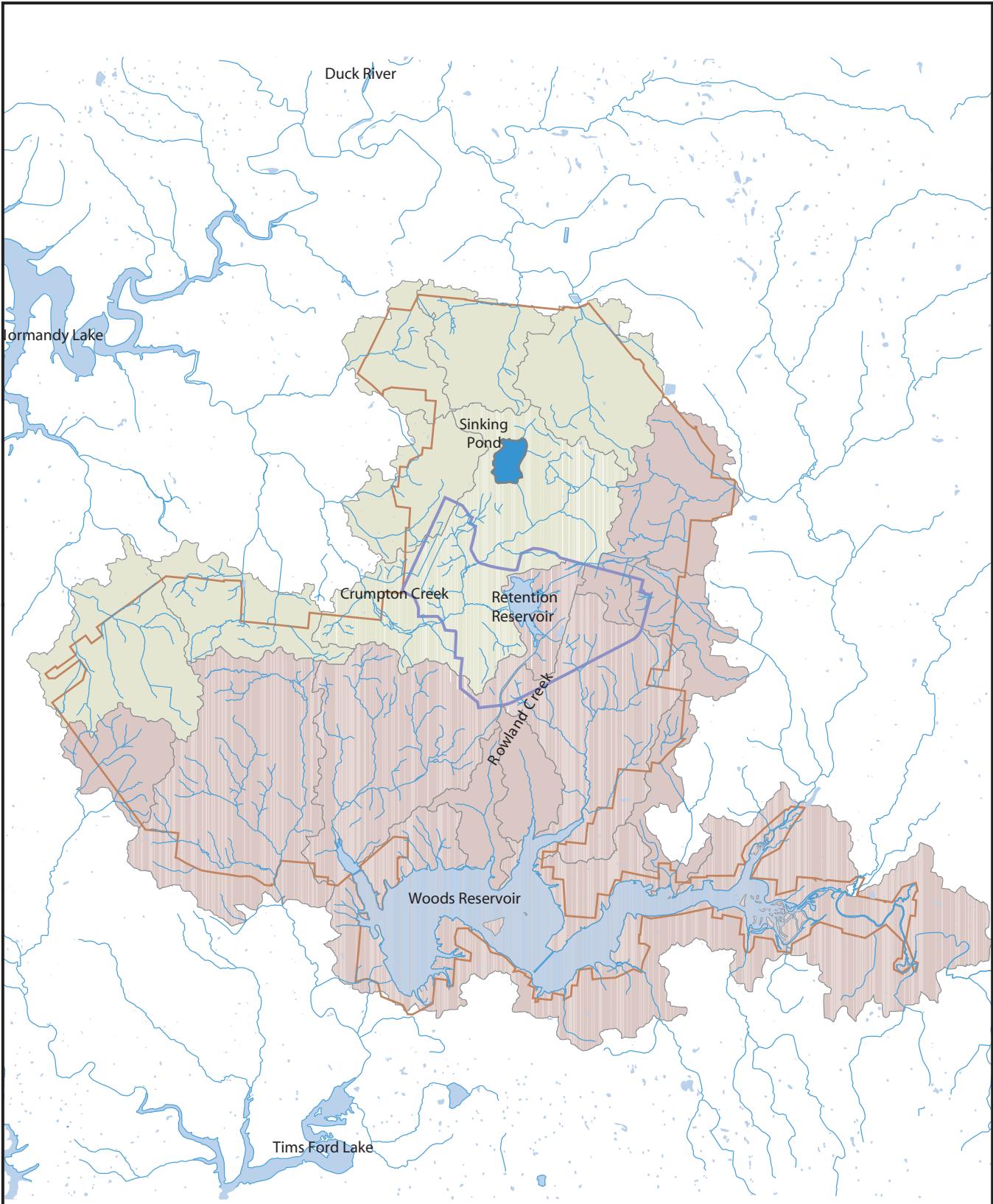
Soils on Arnold AFB primarily belong to the Dickson-Mountview-Guthrie Association and consist chiefly of ultisols developed on a thin (<4.9 ft) silty mantle overlying cherty limestone residuum (Love et al., 1959; Springer and Elder, 1980; Smalley, 1983; Patterson, 1989). The Dickson silt loam and Mountview silt loam are the most important soils on well-drained slopes and ridges. Both of these soils are strongly to very strongly acidic, moderately permeable in their surface horizons, and low in fertility. They differ primarily in that the Dickson soil has a discontinuous fragipan (relatively impermeable layer) at the base of the silty upper mantle that restricts subsoil drainage (Love et al., 1959). The fragipan layer contributes to the patterns of seasonal flooding observed at Arnold AFB by restricting drainage during the wet winter months and by limiting the upward movement during the dry summer months. Guthrie silt loam is the characteristic soil of headwater wetlands in The Barrens. This soil is developed on parent materials similar to those of the Dickson and Mountview soils and contains a discontinuous fragipan. It is strongly to very strongly acidic and low in fertility. The Guthrie silt loam differs from the Dickson silt loam primarily in its poor drainage and landscape position. The most extensive occurrences of Guthrie silt loam occupy the bottoms of intermittent headwater streams and sinkholes.

The Dickson-Baxter-Greendale soil association also occurs on Arnold AFB. It is an extensive soil association on the Highland Rim and occupies 13.3 percent of Coffee County. Typical relief for this association includes large, almost level or undulating areas with steeper slopes near drainageways. The drainage pattern is dendritic, but streams are neither numerous nor well-entrenched. Imperfectly and moderately drained soils predominate in this area (United States Department of Agriculture [USDA] Soil Conservation Service [SCS], 1949).

Dickson, Baxter, and Greendale soils occupy most of the association, with Lawrence, Guthrie, Ennis, and Lobelville soils also present. A small amount of Mountview soil also is found in the area. Dickson soils occur primarily on undulating or nearly level to depressed areas. The upper layers of these soils are generally free of chert, stones, or gravel, and the subsoils are compact and relatively impervious. Mountview soils are chert-free on the undulating uplands. Baxter soils are located in steeper areas along the larger drainages. The cherty Greendale soils are on young, alluvial-colluvial deposits at the base of slopes occupied by Baxter soils and along intermittent streams. Lobelville and Ennis soils occur in long narrow areas on first bottoms along streams (USDA SCS, 1949).

3.3.3 Hydrology

Hydrological features consist of surface waters (lakes, rivers, streams, and springs) and groundwater. Arnold AFB lies within the Duck River and the Elk River basins. The drainage divide between these two watersheds extends southwest to northeast through the AEDC Industrial Area (Figure 3-1). The Duck River basin lies to the north of the divide and receives drainage from Hunt, Huckleberry, Wiley, Crumpton, and Bobo Creeks and the Hickerson Spring Branch. The Elk River basin is to the south of the divide and collects surface drainage, primarily from Bradley, Brumallow, and Rowland Creeks. Smaller creeks such as Dry Creek, Hardaway Branch, Saltwell Hollow Creek, Spring Creek, and Poorhouse Creek also contribute to the Elk River (Call, 2003).



0 7,500 15,000
Feet

Legend

Hydrology	Duck Watershed
AEDC Boundary	Elk Watershed
Arnold AFB Boundary	Reservoirs



Figure 3-1
Watersheds on Arnold Air Force Base
Prescribed Burn
Final Environmental Assessment

Regional groundwater resources include the Mississippi Carbonate (karst) aquifer (recently re-named Highland Rim aquifer). The bedrock formations have a deep (up to 100 ft thick) chert regolith that stores groundwater and releases it to bedrock openings. Groundwater beneath the Arnold AFB area occurs within the regolith, and to a more limited extent within the bedrock. The main water-bearing unit in the area occurs within the chert rubble unit at the base of the regolith just above the bedrock and the solution-openings in the upper portion of the bedrock (Aycock and Haugh, 1999). There are fractures in the bedrock, which permit rapid transmission of water. Well yields commonly range from 5 to 50 gallons per minute (TDEC, 2002a).

Karst areas are characterized by sinkholes, springs, disappearing streams and caves, and rapid, highly directional groundwater flow in discrete channels. Since water can travel rapidly over long distances through conduits that lack natural filtering processes of soil and bacteria, karst systems are easily contaminated.

Floodplains have been defined at several locations on Arnold AFB (Figure 3-2). These areas are located near Woods Reservoir and Sinking Pond.

3.3.4 Water Quality

Within the Duck River basin in the vicinity of the proposed project, there are only two streams that do not fully meet their designated uses. Both the Duck River and the Little Duck River have elevated bacteria levels near the City of Manchester, attributed to failing sewage collection systems within the city and general urban runoff (TDEC, 2002b).

The Upper Elk basin has 12 water bodies on the final version of the 2002 Section 303(d) list, which was issued in January 2004 (United States Environmental Protection Agency [USEPA], 2004). Woods Reservoir in the project area is listed as not supporting its designated uses because of polychlorinated biphenyl (PCB) impairment of sediments resulting from historical PCB releases from AEDC into Woods Reservoir. A No Consumption-General Public (NCGP) fishing advisory has been issued for catfish (TDEC, 2002b).

3.4 Biological Resources

Biological resources include the native and introduced terrestrial plants and animals around Arnold AFB. The land areas at Arnold are home to unusually diverse biological resources including several sensitive species, habitats, and wetlands. Arnold AFB developed a system of ecological associations based on floral, faunal, and geophysical characteristics. These ecological associations are described in the Arnold AFB IEMP (Call, 2003).

3.4.1 Role of Fire in Shaping Biological Community Structure

Prior to European settlement, fire was a major force shaping plant and animal community development in the southeastern United States (Wade et al., 2000). Four fire regimes occurred in southeastern forests, depending on the community types:



0 6,000 12,000
Ft



LEGEND

- █ AEDC Boundary
- █ Floodplain Area
- █ AEDC Boundary



Figure 3-2
Floodplains Located on Arnold Air Force Base
Prescribed Burn
Final Environmental Assessment

understory fire regime, stand replacement fire regime, mixed severity fire regime, and nonfire regime (Brown, 2000).

Prior to European settlement, all four regimes occurred in southeastern forests. The forest types found on Arnold AFB primarily experienced understory fire regimes (Table 3-1). It should be noted that cedar glades, a habitat type similar to the Barrens on Arnold AFB that occurs to the north of the Base had an understory fire regime with a recurrence interval of 3 to 7 years (Wade et al., 2000).

TABLE 3-1
Historic Fire Regimes and Recurrence Intervals for Habitats on Arnold Air Force Base
Prescribed Burn Final Environmental Assessment

Forest Type	Fire Regime	Recurrence Interval
Upland Dry-Mesic Forest (Oak-Hickory-Shortleaf Pine)	Understory	Fires covering more than 25% of aboveground vegetation recurring at less than 10-year intervals.
Upland Dry-Mesic Forest (Oak-Hickory)	Understory	Fires covering more than 25% of aboveground vegetation recurring at less than 35-year intervals.
Woodland/Savanna/Grassland (Oak Savanna)	Understory	Fires covering more than 25% of aboveground vegetation recurring at intervals of 2 – 12 years.
Woodland/Savanna/Grassland (Oak-Hickory Bluestem Prairie)	Understory	Fires covering more than 25% of aboveground vegetation recurring at less than 10-year intervals.
Forested wetlands	Mixed	Understory burns covering more than 25% of the aboveground vegetation occurring at less than 35-year intervals; stand replacement fires covering more than 25% of the area occurring at intervals between 35 and 200 years.

Data from Wade et al., 2000.

3.4.2 Eastern Highland Rim Ecological Association

The eastern Highland Rim region is part of the Mississippian Plateau section of the Western Mesophytic Forest region, supporting a mixed oak-tulip-chestnut forest with accessory stands of beech and hemlock. Relict stands of mixed hardwood-white pine occur on some bluffs above streams. The Barrens is linked to the karst topography and was once an area of tallgrass prairies.

3.4.3 Wildlife Species

Wildlife species at Arnold AFB are those common to the central southeastern United States. A literature review was conducted and identified 5 species of bats, 21 species of rodents, 11 species of amphibians, and 18 species of reptiles that are likely to occur on Arnold AFB. A study was conducted in 2000 to document bird use of wetland flats and depressions (Roberts et al., 2001). This study identified 59 breeding season birds using wetland areas, including 34 neotropical migrant species. Forty-six bird species were identified using the wetland flats and depressions in winter. A list of the species identified during this study is provided in the report (Roberts et al., 2001). Eighty-six bird species have been documented breeding at Arnold AFB (Lamb, 1999, 2000, 2001, 2002, 2003a, 2004a). Including summer residents, migrants, and wintering species, a total of 226 species have been documented at Arnold AFB (J.W. Lamb, unpublished data).

In the 1950s, a comprehensive game management plan was initiated to increase wildlife populations so that reasonable harvests by the public would be possible. From 1954 to 1964, over 17,000 quail, 6,000 pheasant, 64 deer, and 21 turkeys were stocked. In 1974, the stocking of Canada goose began, with 53 geese stocked on the Retention Pond. An additional 50 geese were stocked in 1975. There are now abundant populations of deer, quail, geese, and turkeys on Arnold AFB. Since deer hunting was initiated in 1965, a total of 21,308 deer have been harvested (Call, 2003).

While limited animal mortality typically results from fires, many of the species that occur on Arnold AFB respond favorably to ecosystem fires. For example, following fire, seed production increases in many grasses and forbs, increasing the amount of food available for seed-eating birds and small mammals (Lyon et al., 2000; Huff and Smith, 2000). Also, regrowth following fire provides favorable habitat for ground-nesting birds, and enhanced shrub growth provides greater browse for deer (Huff and Smith, 2000). In addition, incidental mortality to overstory species produces standing dead trees that provide foraging habitat for woodpeckers and nesting habitat for cavity-dwelling species (Huff and Smith, 2000).

3.4.4 Plant Species

The plant species found at Arnold AFB are those common to the eastern Highland Rim Ecological Association. Oak-hickory forest, cedar glades, and a mosaic of bluestem prairie and oak-hickory forest dominate this association. The predominant vegetation form is temperate low land and submontane broad-leaved cold-deciduous forest. Oaks (*Quercus* spp.) are the dominant canopy species. Hickories (*Carya* spp.), including pignut (*C. glabra*), mockernut (*C. tomentosa*), shagbark (*C. ovata*), and bitternut (*C. cordiformis*), form a common but minor component (McNab and Avers, 1994).

Arnold AFB lies in the heart of The Barrens region of the eastern Highland Rim. "Barrens" most often refers to grasslands similar to the Midwestern tallgrass prairie but may also be used to describe openings with scattered trees that may resemble savanna or shrubland. Present vegetation on Arnold AFB is predominantly upland and swamp oak forest. Of the forested areas, 23,492 acres are in native hardwoods and 5,785 acres are in planted, non-native pines. Forested areas are most frequently characterized by closed canopies dominated by various oaks. Dry sites are dominated by post oak (*Q. stellata*), blackjack oak (*Q. marilandica*), scarlet oak (*Q. coccinea*), southern red oak (*Q. falcata*), and black oak (*Q. velutina*). Wet sites are dominated by white oak (*Q. alba*), willow oak (*Q. phellos*), water oak (*Q. nigra*), and overcup oak (*Q. lyrata*). Understories include a wide variety of species including dogwoods (*Cornus* spp.), maples (*Acer* spp.), sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), and blueberries (*Vaccinium* spp.).

Numerous wetlands occur across the Base, with prevailing vegetation ranging from grassland to closed-canopy forest. Several hundred acres of open, prairie-like Barrens occur primarily near the airfield and along powerline and railroad ROWs. The flora of the region has long been noted for its unusual Coastal Plain disjuncts. Coastal Plain disjuncts are species that normally occur only in the Atlantic or Gulf coastal plains. These species are found nowhere else in Tennessee. To date, over 900 vascular plant species have been recorded on the Base (Call, 2003). The Nature Conservancy and the

Tennessee Division of Natural Heritage classified and mapped the vegetation of Arnold AFB. The 33 plant associations delineated for Arnold AFB are listed in Appendix E. Seventeen of the 33 vegetation associations found on Arnold AFB are considered “imperiled” community types.

3.4.5 Sensitive Species

Sensitive species include those with federal endangered or threatened status, species proposed for listing as federal threatened or endangered, and state endangered, threatened, and species of special concern status. A list of all sensitive species on Arnold AFB is provided in Appendix F.

AF projects that may affect federally protected species and species proposed for federal listing are subject to the ESA. The ESA requires designation of critical habitat for federally listed species. However, no areas on Arnold AFB are designated as critical habitat under the ESA. The species present on Arnold AFB that are protected under the ESA are described below.

3.4.5.1 *Myotis grisescens* (Gray Bat)

The gray bat occupies a limited geographic range in the limestone karst areas of the central and southeastern United States. The gray bat typically uses caves for both winter hibernation and summer roosting/maternity, although different caves are used for these two periods and bats may travel up to 325 miles between winter and summer habitat (Whitaker and Hamilton, 1998). Gray bats have narrow temperature requirements, which reduces the number of caves that are suitable for use. The species is particularly vulnerable, as 95 percent of the population hibernates in only nine caves, with over half the population hibernating in a single cave (Rommé and Reaves, 1999).

Gray bats forage primarily on aquatic insects along forested riparian corridors and use other forested corridors as travel routes. The canopy provides protective cover from potential predators (Rommé and Reaves, 1999; Lamb, 2003b). Mist net surveys at Arnold AFB have confirmed this life history characteristic, and gray bats have been captured while foraging along Elk River Bottoms, Bradley Creek, Brumallow Creek, and Rowland Creek. Gray bats also have been recorded with AnaBat II™ at Goose Pond, Sinking Pond, Tupelo Swamp, Westall Swamp, and near the Tennessee Valley Authority (TVA) substation.

Fire is not a significant factor in gray bat life history. However, understory fires can result in a more open subcanopy layer, which could create additional flight corridors for foraging bats.

3.4.5.2 *Myotis sodalis* (Indiana Bat)

The Indiana bat is found in the eastern United States from eastern Oklahoma into Vermont and northwestern Florida. Indiana bats hibernate in caves and typically spend summers under the loose bark of trees in upland and bottomland forests and semi-wooded areas (Whitaker and Hamilton, 1998). Typically, Indiana bats make summer roost in hardwood trees with sloughing bark or cavities (Rommé and Reaves, 1999), but males have been documented roosting among the bark furrows of large pine trees on

Wright-Patterson AFB (R.A. King, USFWS, personal communication, 2004). As with gray bats, Indiana bats may migrate several hundred miles between winter and summer habitat (Rommé and Reaves, 1999).

AnaBat II™ surveys in 2003 identified the possible presence of Indiana bats along Bradley and Brumalow Creeks, but the species has never been captured in mist nets on the Base. (Lamb, 2004b). Fire is not a major factor in the life history of Indiana bats. Although understory fires can result in improved flight corridors, a stand replacement fire occurring in summer could result in complete mortality of a maternity colony from intense heat and smoke.

3.4.5.3 *Haliaeetus leucocephalus* (Bald Eagle)

The bald eagle is a federally threatened species found over most of North America, from Alaska and Canada to northern Mexico. There are an estimated 50,000 bald eagles in the United States, with 80 percent found in Alaska (Murphy et al., 1989).

The bald eagle is the only species of sea eagle that lives in North America. In the Southeast, bald eagles build their nests in early September. They usually build nests in pine trees or bald cypress trees that are 1,000 ft or less from open water. Typically, bald eagles build nests high in trees where they have a clear view of the water. To date, no bald eagles have been documented nesting at Woods Reservoir.

Tennessee's bald eagle population is the highest in winter when birds migrate from the north. Most of the birds winter in western parts of the state, particularly at Reelfoot Lake, and at Dale Hollow Reservoir. However, bald eagles may occur on almost any waterway in the state (TWRA, 2004).

Table 3-2 provides the numbers of mature and juvenile bald eagles observed at Woods Reservoir from 1988 through 2004. In most years a single pair of bald eagles winters on Woods Reservoir. Occasional sightings of transient eagles occur, but the species has not been documented nesting on Arnold AFB.

Eggert's sunflower is the only federally listed threatened plant species known from Arnold AFB. Management actions for the species are integrated with other aspects of the Arnold AFB ecosystem management program by employing a coarse filter-fine filter approach. This approach involves the restoration and maintenance of vegetation structure and ecological processes in suitable habitats for Eggert's sunflower. Such process-oriented management supports mission flexibility by working at multiple spatial and temporal scales to conserve biological diversity associated with one of the Base's focal conservation targets—the Barrens mosaic (Fitch, 2003).

3.4.5.4 *Helianthus eggertii* (Eggert's sunflower)

Prescribed burning, mechanical thinning, and invasive plant management are practices used to manage Eggert's sunflower on Arnold AFB. Because this species grows best in open and edge habitats, it is adapted to respond positively to fire. Eggert's sunflower habitat is maintained through Barrens restoration, forest management, and roads and ground operations, in addition to management of approximately 285 acres designed specifically for the species' conservation (Call, 2003). The management actions are driven by the recovery goals for the species, which are listed in the USFWS Recovery

Plan for Eggert's sunflower (White and Ratzlaff, 2000). Through management, Arnold AFB seeks to minimize the threats to Eggert's sunflower, including vegetation succession, habitat destruction, and competition by invasive plants.

TABLE 3-2
Number of Wintering Bald Eagles at Woods Reservoir (1988-2004)
Prescribed Burn Final Environmental Assessment

Year	Number of Adults	Number of Immature
1988	0	0
1989	2	0
1990	2	0
1991	2	0
1992	2	1
1993	2	0
1994	2	0
1995	1	0
1996	1	0
1997	2	0
1998	2	0
1999	1	0
2000	2	0
2001	2	0
2002	2	0
2003	2	0
2004	1	1
Total	28	2

Data from J.W. Lamb, unpublished data.

3.4.5.5 (*Pleurobema gibberum*) Cumberland Pigtoe

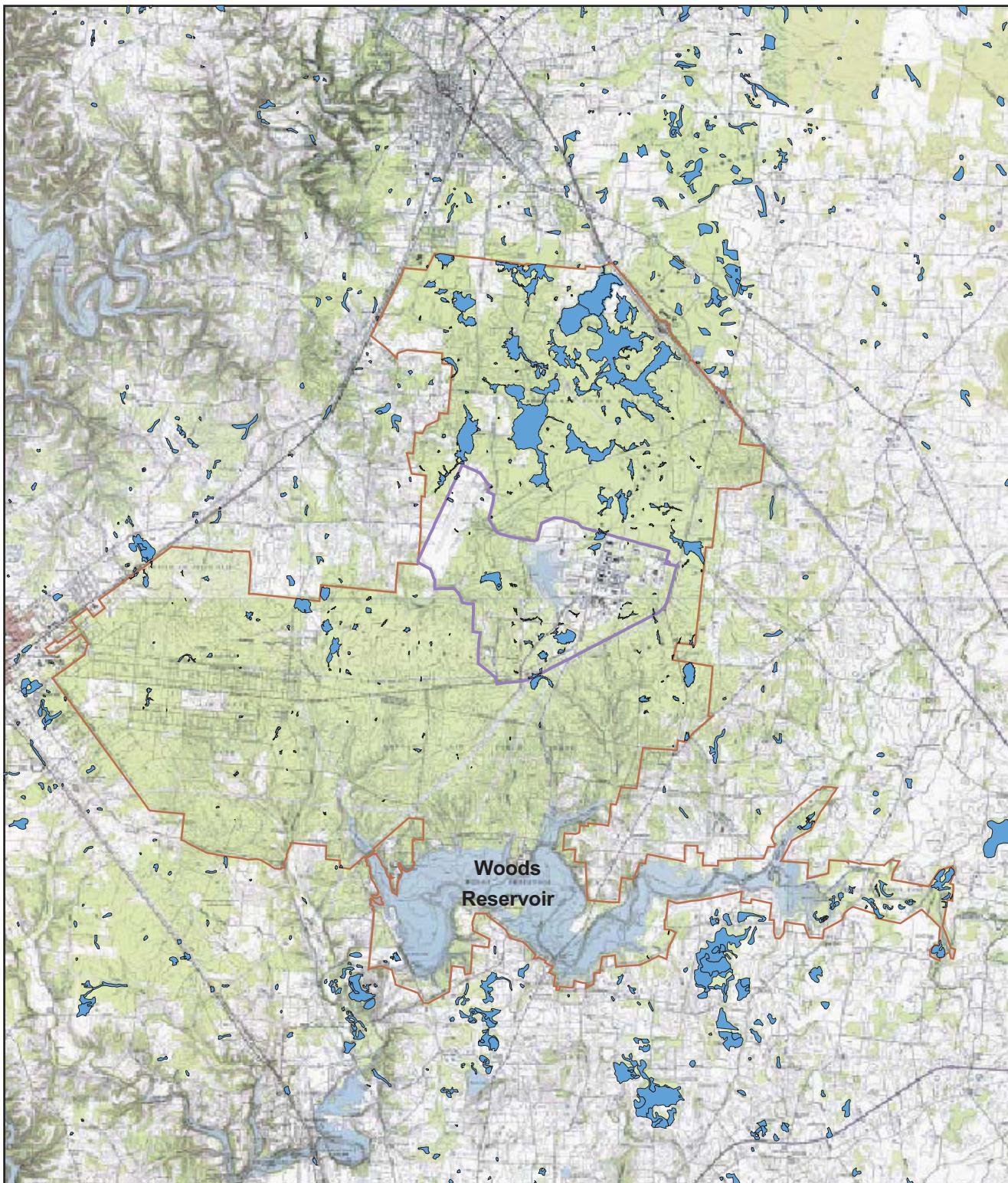
Cumberland pigtoe is a federally threatened aquatic invertebrate bivalve species. A single relict shell was found on Arnold AFB in a 1990 faunal survey (Mullen et al., 1995), but live specimens have never been found on the Base (Call, 2003). Additional relict shells have not been located in surveys conducted by USFWS since 1990 (J.W. Lamb, personal communication, 2004). This species is therefore not considered in this assessment.

3.4.6 Sensitive Habitats

Sensitive habitats are described as those supporting threatened or endangered plant and animal species, areas determined to be exemplary natural communities by federal or state agencies, or habitat areas that are exceptionally fragile and susceptible to damage. The sensitive habitats meeting these criteria occurring on the Base are the wetlands habitat, woodland/savanna/grassland habitat, and upland dry-mesic forests habitat.

3.4.6.1 Wetlands Habitat

Wetland flats and depressions are the two primary wetland types on Arnold AFB. The USFWS completed a wetlands inventory and mapping project on Arnold AFB in 1998 and documented 1,894 acres of wetlands in 220 sites (Figure 3-3). Two hundred



0 1.25 2.5 Miles



LEGEND

- █ AEDC Boundary
- █ Arnold AFB Boundary
- █ Wetlands

Figure 3-3
Wetlands Located on Arnold Air Force Base
Prescribed Burn
Final Environmental Assessment

wetlands on Arnold AFB totaling about 1,775 acres are classified as either flats or depressions. Wetlands at Arnold AFB result from three major geomorphic features: karst pans, compound sinks, and intermittent headwater streams (Call, 2003). Karst pans typically have depths less than 4.9 ft and level bottom topography. Compound sinks generally have depths greater than 8.2 ft and complex bottom topography dominated by internal drainage systems consisting of coalesced sinkholes and connecting channels.

Wetlands associated with headwater streams display a rapid surface water response to localized precipitation events. These areas remain wet for extended periods due to level topography and poorly drained soils.

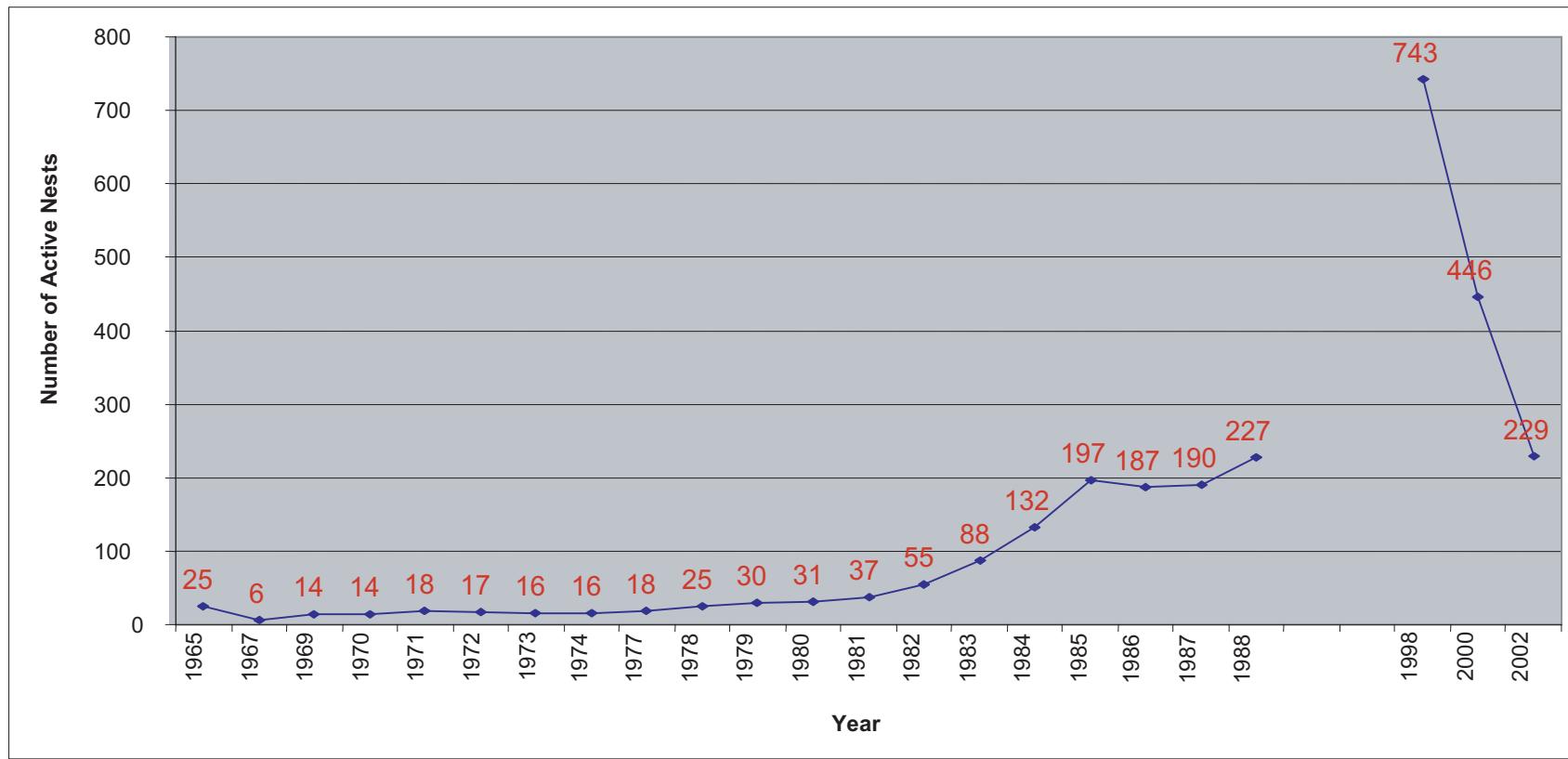
One of the most pristine areas at Arnold AFB, Sinking Pond (a compound sink), is also the site of one of the largest great blue heron rookeries in Tennessee. The number of active great blue heron nests identified at Sinking Pond since 1965 is provided on Figure 3-4. Surveys were not conducted from 1989 through 1997.

According to the IEMP, 10 plant association communities identified as target conservation communities by the IPT are included in the wetland flats and depressions classification. The communities are listed in Appendix E.

Twenty-six species identified as target conservation species by the IPT are associated with wetland flats and depressions. The gopher frog (*Rana capito*) occurs in wetlands on Arnold AFB. The Arnold AFB population of gopher frog is disjunct, separated from the nearest other population by several hundred miles and may represent a distinct, as yet undescribed, subspecies. The three subspecies of the gopher frog recognized in the scientific literature are considered species of concern by the USFWS. Many of the rare plants associated with the wetland flats and depressions classification also are disjunct populations of species whose central ranges are limited to the Atlantic or Gulf Coastal Plains. Several of the disjunct species associated with wetland flats and depressions are documented in Tennessee only from Arnold AFB. A list of all the conservation target species associated with wetlands on Arnold AFB and the wetland types in which they are typically found is provided in Appendix G.

3.4.6.2 Woodland/Savanna/Grassland Habitat

This classification represents a significant component of the Barrens mosaic, which historically characterized much of Arnold AFB and the landscape in which it is situated. The woodland and savanna components include lightly forested, oak-dominated habitats with a grass- and forb-dominated understory. Savannas are grasslands with a minor canopy cover; woodlands are low-density forests with a well developed herbaceous understory. The pre-European burn interval for tallgrass prairie is reported as 1 to 4 years, and prairie plant and animal species are well-adapted to regular fire (Wade et al., 2000). Fire exclusion since approximately the 1940s has led to the succession of most woodland and savanna habitats into forested habitats with shrub-



Data for 1965 through 1988 from Pullin (1980 and 1990). Data for 1998 from Carter et al. (1998). Data for 2000 and 2002 from J.W. Lamb (unpublished data).



Figure 3-4
Number of Great Blue Heron Nests Identified at Sinking Pond from 1965 through 2002
Prescribed Burn
Final Environmental Assessment

dominated understories (e.g., some communities included in the upland dry-mesic forest described below). However, aerial photography from the late 1930s indicates that a woodland/savanna mosaic was a dominant habitat in the premilitary landscape on Arnold AFB.

Grasslands are the habitat most commonly described in the scientific literature regarding The Barrens of Tennessee. Representative species include big bluestem, little bluestem, Indian grass, and various switch grasses. Barrens habitat probably occurred historically as scattered openings in the woodland/savanna mosaic, but also have undergone vegetative succession in the absence of wildfire across much of the landscape. Fire is believed to have been the major factor in keeping the Barrens from developing into closed canopy forest in pre-European times (Wade et al., 2000). Following European settlement, many barrens-type areas were burned annually to provide greater forage production and maintain an open landscape (Wade et al., 2000).

The grasslands at Arnold AFB are dominated by grasses characteristic of tallgrass prairies in the midwestern United States, and also include many wildflower and bird species associated with that region.

According to the IEMP (Call, 2003), seven vegetation communities identified as conservation targets by the IPT are included in the woodland/savanna/grassland classification (Appendix E). Their distributions are linked to ecological gradients that are influenced by soil series, moisture, disturbance, and topographic position, among other factors.

There are 18 species and 1 species guild identified as conservation targets by the IPT in woodland/savanna/grassland habitats. The species are divided into two groups: one associated with dry sites and the other with mesic sites (Appendix H). Some of the species may occur across the soil moisture gradient, but they are associated here with the habitat in which they are commonly found. Eggert's sunflower is the only federally listed (threatened) species associated with woodland/savanna/grassland. The guild identified for the classification is songbirds that utilize early successional habitats cited by Partners in Flight in the Interior Low Plateaus Draft Bird Conservation Plan (Ford et al., 1998). Species of concern include:

- Henslow's Sparrow (*Ammodramus henslowii*)
- Bachman's Sparrow (*Aimophila aestivalis*)
- Grasshopper Sparrow (*Ammodramus savannarum*)
- Blue-Winged Warbler (*Vermivora pinus*)
- Prairie Warbler (*Dendroica discolor*)
- Northern Bobwhite (*Colinus virginianus*)
- White-Eyed Vireo (*Vireo griseus*)

These birds are seed-eaters and nest either on the ground or in low vegetation. These birds would be expected to show a positive response to fire that occurs outside the nesting season.

3.4.6.3 Upland Dry-Mesic Forests Habitat

The most prevalent habitat type on Arnold AFB lands is the upland forests that occupy most of the broad ridges and slopes on the Base. Portions of this forest may present opportunities for restoring woodland or savanna communities, such as those present historically. However, the upland dry-mesic forests are also regionally important in their current condition, as large, contiguous forested tracts are uncommon in the southeastern portion of the Highland Rim physiographic province. The larger, mature forest tracts on Arnold AFB provide important breeding territory for interior forest songbirds and also help in many ways to maintain the function of nearby wetland habitats.

Five conservation target communities are included in the upland dry-mesic forests classification (Appendix E).

The upland dry-mesic forests collectively have focal conservation targets on Arnold AFB. Five community types are included in the upland dry-mesic forest classification:

- *Quercus falcata* - *Quercus coccinea* - *Quercus (stellata, velutina)/Vaccinium pallidum* forest (Southern red oak - scarlet oak - post (black) oak/lowbush blueberry forest)
- *Quercus falcata* - *Quercus alba* - (*Quercus coccinea*)/*Oxydendrum arboreum/Vaccinium pallidum* forest (Southern red oak - white (scarlet) oak/sourwood/lowbush blueberry forest)
- *Quercus alba* - *Quercus (falcata, stellata)/Chasmanthium laxum* forest (White oak - southern red (post) oak/slender woodoats forest)
- *Juniperus virginiana var. virginiana* - *Quercus* spp. forest (Eastern red cedar - oak forest)
- *Juniperus virginiana var. virginiana/Rhus copallina/Schizachyrium scoparium* forest (Eastern red cedar/winged sumac/little bluestem forest)

The single conservation target species guild identified is interior forest songbirds that require large (i.e., >500 acres) contiguous forest tracts for establishing breeding territories and includes:

- Wood Thrush (*Hylocichla mustelina*)
- Scarlet Tanager (*Piranga olivacea*)
- Ovenbird (*Seiurus aurocapillus*)

The original forest vegetation on Arnold AFB consisted of an oak-hickory forest type on the better-drained soils and a mixed bottomland hardwood type on the poorly drained soils. Historical timber harvest practices and the forest burning activities used to maintain woodland pasture for over 100 years have resulted in species composition of primarily blackjack oak, post oak, and scarlet oak on the poorer upland soils. Stands of southern red oak, white oak, water oak, and willow oak occur on the wetter sites.

3.5 Cultural Resources

Section 106 of the NHPA requires that federal agencies analyze the impacts of federal activities on historic properties. Areas potentially impacted by mission activities are surveyed as part of the AF Cultural Resources Management Program.

Surveys conducted on Arnold AFB have identified 107 prehistoric and historic sites dating back to Early Archaic times (Hajic et al., 2002). These include 40 prehistoric sites, 55 historic sites, and 12 mixed prehistoric and historic sites. Of these 107 sites, 6 have been deemed eligible for listing on the National Register of Historic Places (NRHP) and 40 are considered potentially eligible (R. Alvey, personal communication, 2004). A total of 340 buildings on Arnold AFB were surveyed by Geo-Marine Inc, and 100 of these structures are considered potentially eligible for listing on the NRHP (Peyton, 2004a; 2004b; R. Alvey, personal communication, 2004). In accordance with NRHP eligibility criteria, most notably Criteria Consideration G, 31 facilities at Arnold AFB have exceptional significance and are recommended as eligible for the NRHP. The facilities illustrate the Cold War heritage of the United States in the area of materiel development, and they illustrate key Cold War themes, especially in the area of science and technology.

Camp Forrest was founded in 1941 and was located mostly within present Base boundaries. Encompassing 85,000 acres, it was one of the nation's largest training centers just before World War II. Approximately 22,000 prisoners of war were housed here, representing a number of nationalities, including resident aliens, Germans, and Italians (TRC Garrow Associates et al., 2001). There are four surviving structures associated with Camp Forrest: two small concrete utility buildings of unknown use, a former brick jail, and a cold storage building. These resources were recommended as ineligible for the NRHP due to loss of integrity and loss of context caused by the removal of Camp Forrest (TRC Garrow Associates et al., 2001).

There are also five family cemeteries on the Base. These are small family plots that do not contain graves of extreme age, nor are they associated with persons or events of great significance. They also do not evidence distinctive design features. Thus they are considered ineligible for the NRHP (TRC Garrow Associates et al., 2001).

3.6 Environmental Restoration Program and Hazardous Materials

Arnold AFB has an active ERP designed to protect human health and ensure that natural resources are restored for future use (CH2M HILL, 2002). Twenty-six ERP sites have been identified on Arnold AFB, 11 of which have been closed after determinations of no further action required.

Two SWMUs are located in or near areas where prescribed burns have occurred, are planned, or may occur in the future. SWMU 24 encompasses the former Camp Forrest U.S. Army Base. SWMU 98 is the location of the former explosive ordnance disposal range.

3.6.1 SWMU 24

SWMU 24 is approximately 5,000 acres in size and encompasses 85 separate potential contaminant source areas. These source areas are former gas stations, motor pools, vehicle maintenance areas, warehouses, fuel storage and distribution areas, a coal pile, an incinerator, and two landfills. These sites were active between 1941 and 1946, when Camp Forrest was decommissioned and dismantled. Most of SWMU 24 is now overgrown with vegetation. Current uses include forestry, wildlife management, and recreation.

Sites with the potential for contamination within SWMU 24 were evaluated from 1999 to 2004. During the Confirmatory Sampling Program, organic chemicals were found in low concentrations at some sites. These include xylene, ethylbenzene, pesticides, acetone, and phthalates. Arsenic or other metals slightly above background levels were also detected at some sites. Sixteen of the 85 sites were then investigated in a RCRA Facility Investigation (RFI). Seven of the former fuel handling sites were found to have surface soils with contaminants exceeding USEPA human health or ecological screening levels, primarily polycyclic aromatic hydrocarbons (PAHs) and lead. The two former landfills and the former incinerator also had surface soil contamination exceeding screening levels, including semivolatile organic compounds (SVOCs), metals, pesticides, PCBs, and dioxins. Former Landfill 1 and the former incinerator site are the two areas with the highest levels of surface soil contamination. The incinerator is located on a 1-acre site in the northeastern corner of Camp Forrest in Area A, on Road 14. The landfill is adjacent to the incinerator and encompasses approximately 17 acres. A fence around the incinerator and landfill restricts access to those properties (CH2M HILL, 2001).

3.6.2 SWMU 98

SWMU 98 is an open grass field approximately 10 acres in size located 1,600 feet south-southwest of the Base airstrip. An investigation of the site was completed in 2004. It resulted in the removal of 692 pieces of ordnance explosive, ordnance-related scrap, and unrelated scrap. Data collected on soils during that investigation indicate that VOCs and perchlorate are present, but at concentrations that do not pose a contact risk or risk to groundwater. Metals (i.e., arsenic, cadmium, chromium, and zinc) were detected above USEPA screening values in one sediment sample collected from a drainage ditch, but they are not considered to pose a risk to aquatic organisms (CH2M HILL, 2004).

4.0 Environmental Consequences

4.1 Occupational Health and Safety

4.1.1 Proposed Action

A PBP would be developed for each burn event. This plan would outline safety procedures and identify the conditions (weather, fuel moisture content) for conducting the burn. The PBP would also identify steps to be taken if a prescribed burn escapes the target area.

A JSA has been developed at the Base for prescribed burn operations. Personnel participating in each prescribed burn must read, understand, and sign the JSA before participating in any prescribed burn. Specific JSAs have been prepared for chainsaw use and for loading, transporting, and unloading heavy equipment. These activities are part of many prescribed burning events, and the specific JSAs would be reviewed and signed by the appropriate personnel when these activities are anticipated for a prescribed burn. The JSA process would be conducted in conjunction with a review of the Fire Safety Guidelines of the individual PBP with all personnel who would work on a given prescribed burn.

Arnold AFB has a prescribed burn notification and approval process that would be adhered to prior to all burn activities. A PBP would be prepared for each area to be burned and would be submitted to the Arnold AFB Natural Resource Manager in the Environmental Management Directorate. The PBP would outline the weather parameters and emergency and safety information requirements for the prescribed burn activity. The day before burn activities, a burn map with burn units and acreage would be routed to the Base Fire Department, AEDC Public Affairs Office, Security Dispatchers, ATA, and the Environmental Management Directorate. After issuance of the burn permit by the Tennessee Division of Forestry, on the day of the burn the Environmental Management Directorate would issue final approval based on review of the burn potential from low to high Fire Danger Ratings (1 to 3 ratings). For very high Fire Danger Ratings (rating 4), the Environmental Management Directorate and Arnold AFB Fire Chief would issue final approval for the prescribed burn. For Extreme Fire Conditions (rating 5), the AEDC Commander would have the final approval to authorize the prescribed burn activities.

Smoke from prescribed burns could obscure roadways on or adjacent to the Base. Areas near roadways would be burned only when wind conditions are appropriate to prevent drift of smoke across roads. Arnold has procedures to handle traffic flow and driver safety in the event of a wind change. These procedures range from hazard warnings to road closure, depending upon the severity of the smoke.

Because of the measures described above, impacts to occupational health and safety would be minor during prescribed burn events.

4.1.2 No-Action Alternative

Under the No-Action Alternative, prescribed burning would not be used as a resource management tool. Fuel loads on forest floors would not be reduced and the likelihood of uncontrolled wildfire occurring would increase. These wildfires could spread to offbase locations, endangering the surrounding communities.

4.2 Air Installation Compatible Use Zone and Airfield Operation

4.2.1 Proposed Action

Prescribed burning could result in the production of smoke around the airfield.

Fire planning, including generation of a smoke screen, would be considered and all smoke-sensitive areas and areas selected for prescribed burning would be evaluated to avoid impacts to airfield, flight, and other military mission operations. Prescribed burns would not impact the accident potential zones (Figure 4-1) because the burning activity is compatible with these zones. Appropriate notifications and prescribed burn schedules would minimize impacts on airfield operations.

Due to the measures described above, no negative impacts to airfield operation are expected to occur as a result of prescribed burns.

4.2.2 No-Action Alternative

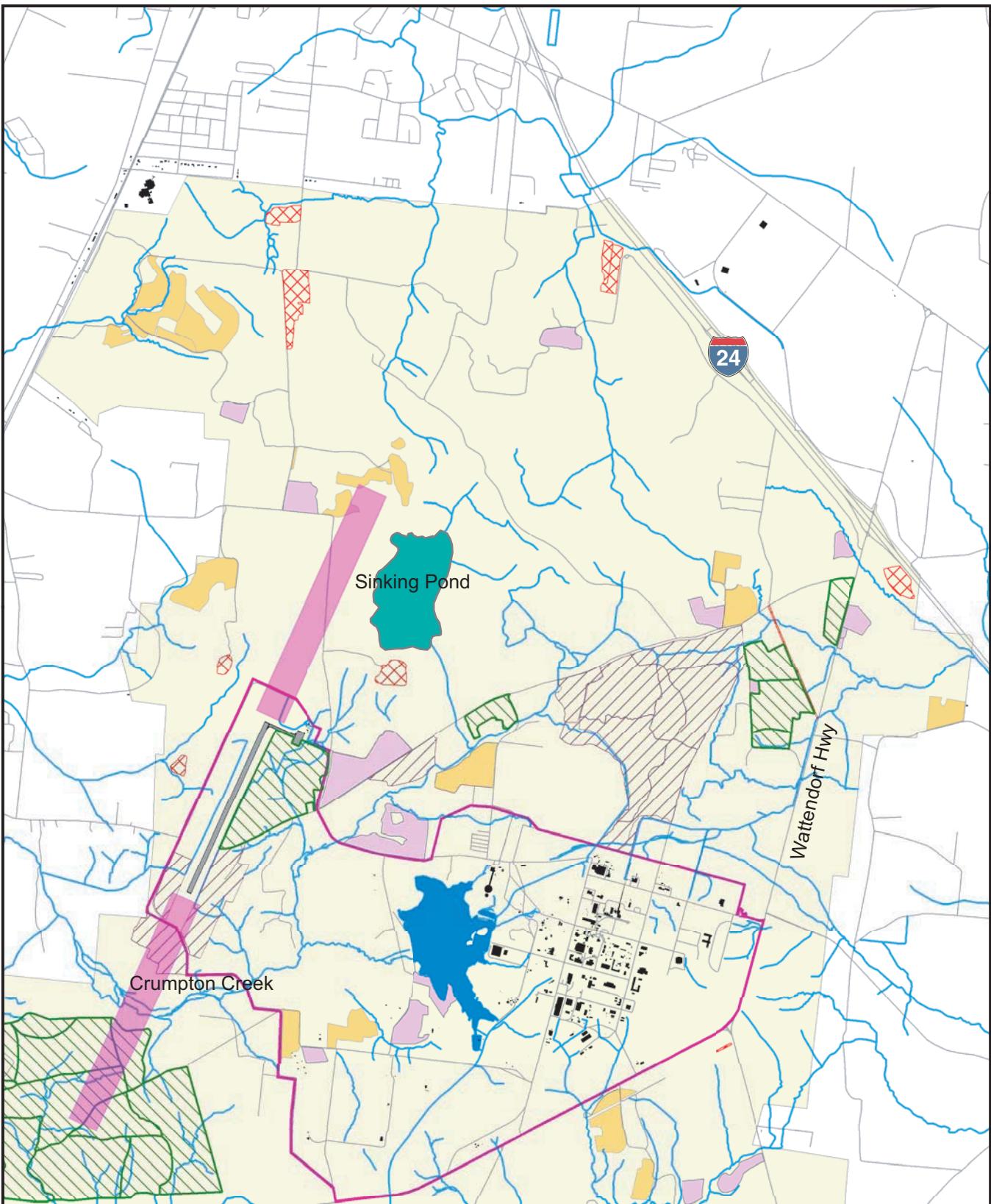
There would be no impacts to the airfield management or airfield operation with the No-Action Alternative.

4.3 Air Quality

4.3.1 Proposed Action

Prescribed burning would result in the production of combustion emissions, including smoke, carbon monoxide (CO), volatile organic compounds (VOCs), and associated fine particulate matter. State regulations for prescribed burns and the Arnold AFB FMP specify the conditions under which prescribed burns may be conducted to minimize potential impacts to air quality. Combustion emissions from heavy equipment used to create and maintain firebreaks would be minor and of short duration and thus are not estimated. Conducting prescribed burns on Arnold AFB is not expected to cause deterioration of regional air quality.

The average annual prescribed burn acreage used to estimate air emissions was 2,900 acres (1,174 hectares). For the emission calculations, all of this acreage was assumed to be short needle pine forest. In actuality, this acreage may be represented by 30 to 50 percent Barrens mosaic. In addition, the average fuel loading assumed (for southern forests) was 20 megagrams (Mg) fuel/hectare.



0 1,250 2,500
Feet

- █ Proposed Burn 06
- █ Proposed Burn 05
- █ TWRA Burn 05-06
- █ Barrens Restoration Burn 06
- █ Barrens Restoration Burn 05
- █ Airfield
- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- █ Reservoirs
- Air Accident Potential Zones
- █ Arnold AFB Boundary



Figure 4-1
Proposed Burn Areas and Airfield Management
Prescribed Burn
Final Environmental Assessment

Table 4-1 outlines the annual emissions associated with the proposed prescribed burn activities and the assumptions noted above.

TABLE 4-1
Proposed Action Annual Average Prescribed Burn Air Emissions
Prescribed Burn Final Environmental Assessment

Pollutant	Emission Factor ^a	Proposed Action Emissions
PM ₁₀	13 g/kg fuel	336 tpy
CO	175 g/kg fuel	4,518 tpy
VOC	3.5 g/kg fuel	90 tpy
NOx	4 g/kg fuel	103 tpy

^a Source: USEPA, AP-42, Section 13.1, 10/96 ed.

PM₁₀ = particulate matter less than or equal to 10 microns in aerodynamic diameter; g/kg = grams per kilogram; tpy = tons per year

As noted in Table 4-1, these emissions represent pollutant increases above baseline or the No-Action Alternative. However, the major pollutant of concern associated with prescribed burns is smoke. Two major adverse characteristics of smoke are its opacity (reducing visibility) and its particulate content, represented by PM₁₀. Adhering to the state regulations and the Arnold AFB FMP should minimize these impacts on operations at the Base and the surrounding area. In addition, according to Tennessee Air Regulations (Chapter 1200-3-9-.04(5)(f)(7)), and communication with AEDC (Philip Sherrill, personal communication, 2004), these open burning operations are exempt from regulation.

4.3.2 No-Action Alternative

No prescribed burns and no associated combustive emissions and fine particulate matter would result from implementation of the No-Action Alternative. Therefore, the No-Action Alternative would have no impacts on air quality.

4.4 Geomorphology

Prescribed burns and associated firebreak construction and maintenance would not change the underlying geology or the topography at Arnold AFB. However, minor localized soil disturbance could result from the construction and maintenance of firebreaks.

4.4.1 Proposed Action

The Proposed Action would include construction and maintenance of firebreaks every year. The number and size of firebreaks would be the minimum needed to safely implement the prescribed burning program. Construction and maintenance of firebreaks involves minor grading to remove potential fuels from an area of sufficient width that a fire would not be likely to cross the break and continue to burn. Once the adjacent prescribed burns are completed, the material graded from the firebreak would be

returned to the firebreak and spread over the disturbed area. Implementation of appropriate Best Management Practices (BMPs), consistent with the Tennessee Erosion and Sedimentation Control Act and the Tennessee Guidelines for Forestry BMPs, would prevent excessive damage to soils during construction and maintenance of firebreaks. Any disturbance to soils would be temporary and minor.

Arnold AFB is developing an erosion control database to assist with land management. The database would document erosion problems, maintain information regarding those problems, identify possible measures to control erosion problems and/or measures implemented, and record development following implementation of control measures. This database would provide information on areas where soil problems could result from firebreak construction and maintenance and allow Arnold AFB to improve the placement of firebreaks in the future.

Therefore, for the reasons stated above, construction and maintenance of firebreaks would result in minor impacts to the geomorphology of Arnold AFB.

4.4.2 No-Action Alternative

No construction and maintenance of firebreaks and no associated soil disturbance would result from implementation of the No-Action Alternative. Therefore, the No-Action Alternative would have no impacts on geomorphology.

4.5 Hydrology and Water Quality

4.5.1 Hydrology

Impacts to hydrology could result from land clearing, loss of vegetation, and associated increased runoff following precipitation events. Increased site runoff could result in a more rapid stream rise and an increased potential for flash floods. Increased runoff could also result in reduced groundwater levels through loss of recharge and lower resultant stream baseflow.

4.5.1.1 Proposed Action

As part of the planning process, prescribed burns would be spaced to prevent concentration of potential impacts in a small area. This would allow the ecosystem to assimilate the effects of burning without substantial change and would help minimize potential hydrologic impacts. Following a prescribed burn, there would be a minor increase in runoff resulting from loss of ground cover. However, overstory vegetation would remain to reduce the erosive force of precipitation. Ground vegetation and leaf litter would re-establish following burns, thus minimizing runoff potential.

4.5.1.2 No-Action Alternative

No prescribed burn and no associated vegetation removal or soil disturbance would result from implementation of the No-Action Alternative. Therefore, the No-Action Alternative would have no impacts on hydrology.

4.5.2 Water Quality

Adverse impacts on water quality could occur as a result of (1) nutrient transport in runoff following burns or (2) disturbed soils on firebreaks. Transport could occur downslope, into immediately adjacent waters, or downstream from a headwater wetland that is within a burn area. Impacts to waters may result from:

- Sediment - soil material suspended in water resulting from erosion. Sediment from runoff causes cloudy water and covers the bottom of streams and lakes. These conditions limit the ability of aquatic organisms to breathe, feed, and reproduce.
- Nutrients - chemical elements required by plants and animals to live and grow. Ash remaining after a burn would contain readily available nutrients that could be transported into waters. Excess nutrients can be toxic to aquatic life, cause undesirable aquatic plant growth, and change water color.
- Elevated Water Temperature - caused by direct sunlight resulting from canopy removal adjacent to waterways. Elevated water temperature limits the ability of aquatic organisms to breathe, feed, and reproduce (TDA, Division of Forestry, 2003).

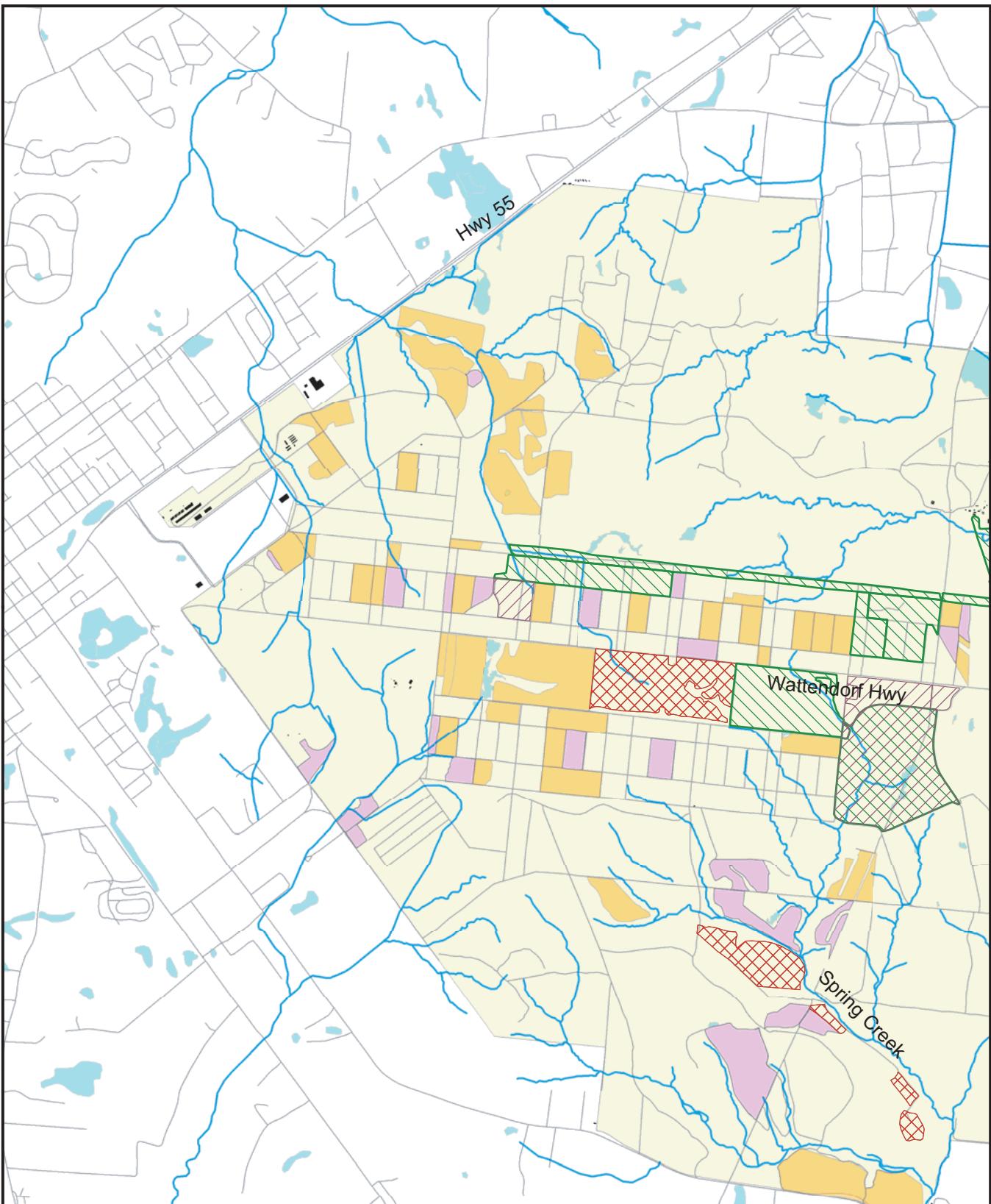
4.5.2.1 Proposed Action

Prescribed burning would release nutrients contained in the organic matter found on the forest floor (Douglass et al, 1982). These nutrients could enter nearby streams in surface runoff from storm events. Other potential impacts to waters would be limited to those resulting from sediments and wood ash.

The headwaters of a Spring Creek tributary southeast of Camp Forrest are within an area scheduled to be burned in 2004-2005 (Figure 4-2). This area is level, and the potential for runoff from surrounding lands is low. Two tributaries of Doorhouse Creek in the southwestern corner of the Base flow through areas scheduled for prescribed burns in 2006 (Figure 4-2). Both tributaries are in gently sloping terrain, and the potential for runoff from surrounding lands is low. In addition, a tributary of Crumpton Creek at the western edge of the Base lies within an area scheduled for prescribed burn in 2004-2005 (Figure 4-3). This stream is located in relatively level terrain and the potential for runoff from surrounding lands is low.

None of the sites scheduled for prescribed burns in 2005 and 2006 in the northern part of Arnold AFB contain streams or wetlands (Figure 4-3). No sites scheduled for burns in 2005 on the eastern part of the Base contain waters, but two tributaries of Woods Reservoir flow through sites scheduled to be burned in 2006 (Figure 4-4). These streams are located in moderately steep terrain, and the potential for runoff entering the streams is greater than for streams in the western part of the Base. Established root systems of woody vegetation along the slopes would stabilize the soil and reduce the potential for erosion and sedimentation. Burns in these areas would be scheduled immediately preceding the start of the spring growing season so that vegetation can quickly recolonize the burn area and limit runoff.

It is anticipated that the streamside management zones (SMZs) would intercept runoff from surrounding uplands and assimilate any sediment, and wood ash prior to runoff



0 1,250 2,500
Feet

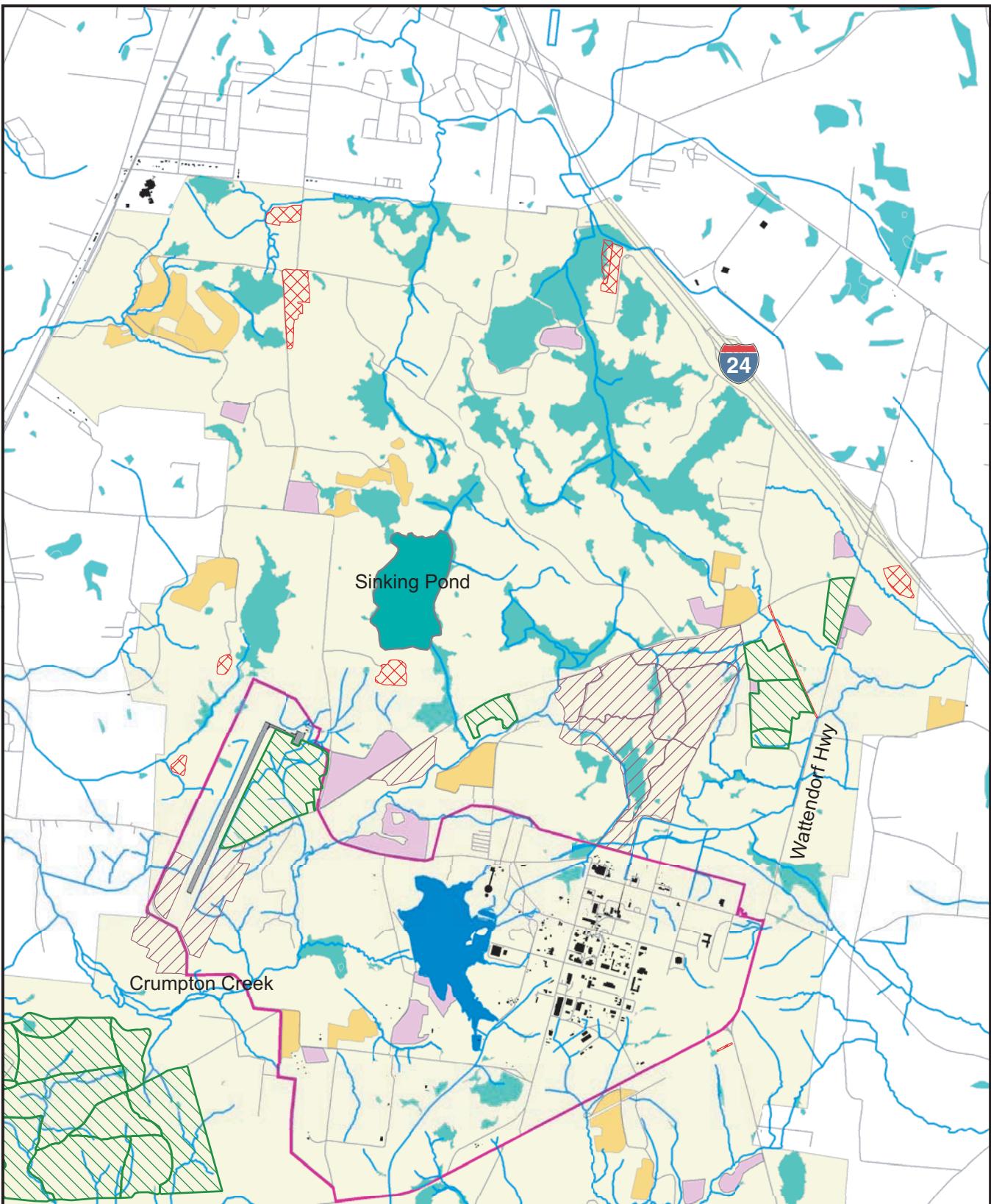


- Proposed Burn 06
- Proposed Burn 05
- TWRA Burn 05-06
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05

- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- Arnold AFB Boundary
- Wetlands



Figure 4-2
Wetland and Stream Locations and Prescribed Burn Sites - Western
Prescribed Burn
Final Environmental Assessment



0 1,250 2,500
Feet

- Proposed Burn 06
- Proposed Burn 05
- ☒ TWRA Burn 05-06
- ☒ Barrens Restoration Burn 06
- ☒ Barrens Restoration Burn 05
- Airfield
- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- Reservoirs
- Wetlands
- Arnold AFB Boundary



Figure 4-3
Wetland and Stream Locations and Prescribed Burn Sites - Northern Prescribed Burn Final Environmental Assessment



- Proposed Burn 05
- Proposed Burn 06
- AEDC Boundary
- TWRA Burn 05-06
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05
- Road Centerline
- Buildings
- Streams
- Reservoirs
- Arnold AFB Boundary
- Wetlands

0 1,250 2,500
Feet



Figure 4-4
Wetland and Stream Locations and Prescribed Burn Sites - Eastern Prescribed Burn Final Environmental Assessment



entering the stream. The roots of woody vegetation in the riparian areas also would help to stabilize the soil and reduce erosion potential. Water quality impacts from any nutrients passing through the SMZs would be minor and short term. Therefore, no significant impacts to water quality would result from burning the organic matter found on the forest floor. Canopy vegetation would remain intact following prescribed burns, and no impacts to water quality would occur as a result of elevated water temperature following prescribed burns.

Firebreaks are cleared areas established to prevent the escape of controlled fires by removing areas of potential fuel. Improperly designed, located, and/or constructed firebreaks can produce large amounts of sediment, and water pollution can occur if sediment from these firebreaks enters water bodies. To minimize the potential for water pollution from firebreaks, the number of firebreaks would be limited and existing firebreaks would be used where possible. Runoff from firebreaks would be prevented from flowing directly into a stream and firebreaks would not cross streams, drains, other wet areas, or sensitive areas. Heavy equipment would not be operated in streams during firebreak construction and maintenance.

Discharge of fuels and lubricants into waters of the State of Tennessee as part of equipment maintenance and refueling is a violation of the Tennessee Water Quality Control Act (TWQCA). Vehicle operation, refueling, and maintenance during prescribed burns and associated fire break construction and maintenance would involve fuels and petrochemicals that could impact water quality if released into the environment. However, the burn crew would follow proper procedures and BMPs for operation, maintenance, and refueling of vehicles to minimize or avoid impacts to water quality from accidental spills. These procedures include keeping all vehicles and equipment in proper operating condition, conducting refueling and maintenance activities at least 100 ft from an intermittent or perennial stream or a wetland, and storing all fuels and lubricants in proper containers and cabinets more than 100 ft from any stream or wetland.

The actions described above would avoid or minimize impacts to water quality. Therefore, no more than minor, temporary adverse impacts to water quality are expected to result from the Proposed Action.

4.5.2.2 No-Action Alternative

No prescribed burn would occur, and no associated disturbance would result from implementation of the No-Action Alternative. Therefore, the No-Action Alternative would have no direct impacts on water quality. However, the potential for wildfire would increase under the No-Action Alternative. A wildfire would be more likely to kill overstory vegetation and cause openings in the canopy. Also, the likelihood of canopy openings over waters would be greater under the No-Action Alternative, which could result in elevated water temperatures.

4.6 Biological Resources

Impacts would occur if proposed burn activities were to physically damage or kill an individual of a species, disturb or displace a species without causing physical harm, or

alter habitat. This section examines potential impacts and discusses project design features that would be implemented to avoid or minimize impacts.

4.6.1 Non-Sensitive Species

4.6.1.1 Proposed Action

Prescribed burning would result in the loss of leaf litter and most understory vegetation. This would be a direct localized loss of plant species. However, plants would recolonize or resprout in the burn area quickly following the burn. Where prescribed burns are scheduled to support restoration of the Barrens mosaic on Arnold AFB, the vegetation changes after the burn would be desirable and consistent with the IEMP approach on Arnold AFB. Trees would be killed depending upon the severity of the fire and would create open and semi-open conditions. These conditions are favorable for propagation of big bluestem, little bluestem, Indian grass, various switch grasses and Panicums, Eupatorium, and occasional rare coastal plain and prairie disjuncts (Call 2003). Grasslands are a feature associated with the eastern Highland Rim barrens. The frequency of disturbance (e.g. fire, grazing, and mowing) determines the dominance of graminoids and forbs.

Within pine stands, burns would maintain proper fuel loads and promote growth of pines through reduced competition. Therefore, the impacts to vegetation would be minor and easily assimilated.

Animal species that utilize burn areas would be displaced during and immediately following the burn. Limited incidental mortality to animals may occur. The acreage to be burned in a given year is approximately 3 percent of the total forest area on Arnold AFB. Because of the relatively small area to be burned and the proximity of suitable replacement habitat, any impacts to non-sensitive species are expected to be temporary and minor.

4.6.1.2 No-Action Alternative

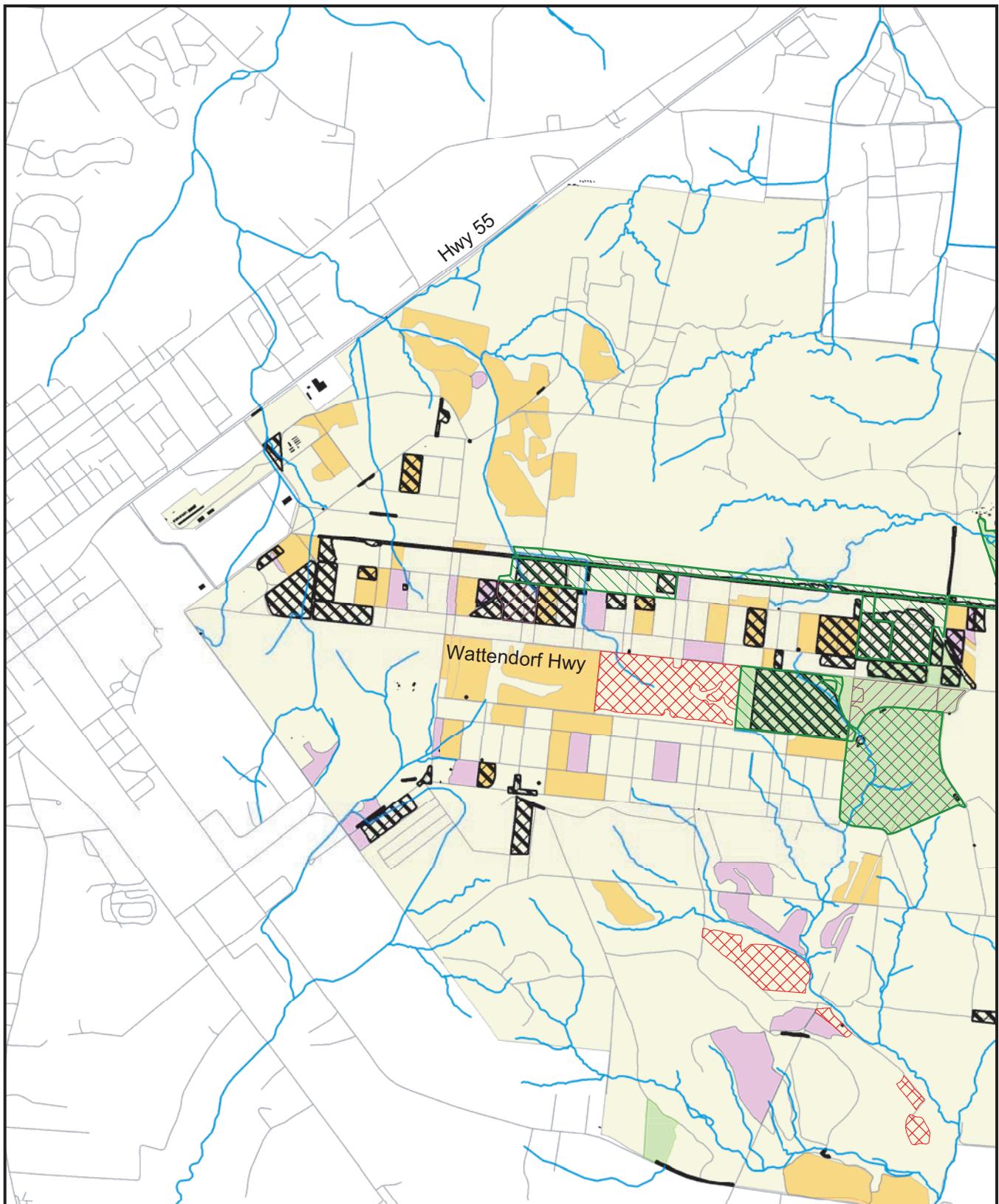
Under the No-Action Alternative, no prescribed burn activity would occur. This could result in continued growth of plants unsuitable for restoration of the Barrens mosaic. Elevated fuel loads could develop in pine forests and lead to an uncontrolled wildfire that could result in loss of organic soil and a substantial and undesirable shift in vegetative composition.

4.6.2 Sensitive Species

4.6.2.1 Proposed Action

Gray Bat

Gray bats have been observed over much of the Base, with a maternity colony and a bachelor colony inhabiting Woods Reservoir Dam during the summer (Figures 4-5 through 4-7). The Proposed Action would not cause direct physical injury to gray bats, as no bats would be present at burn sites during prescribed burns. Gray bats do not roost in trees, and they forage at night when burning activities would have ceased. Residual heat and smoke may cause a temporary shift in gray bat foraging locations.



0 1,250 2,500 Feet

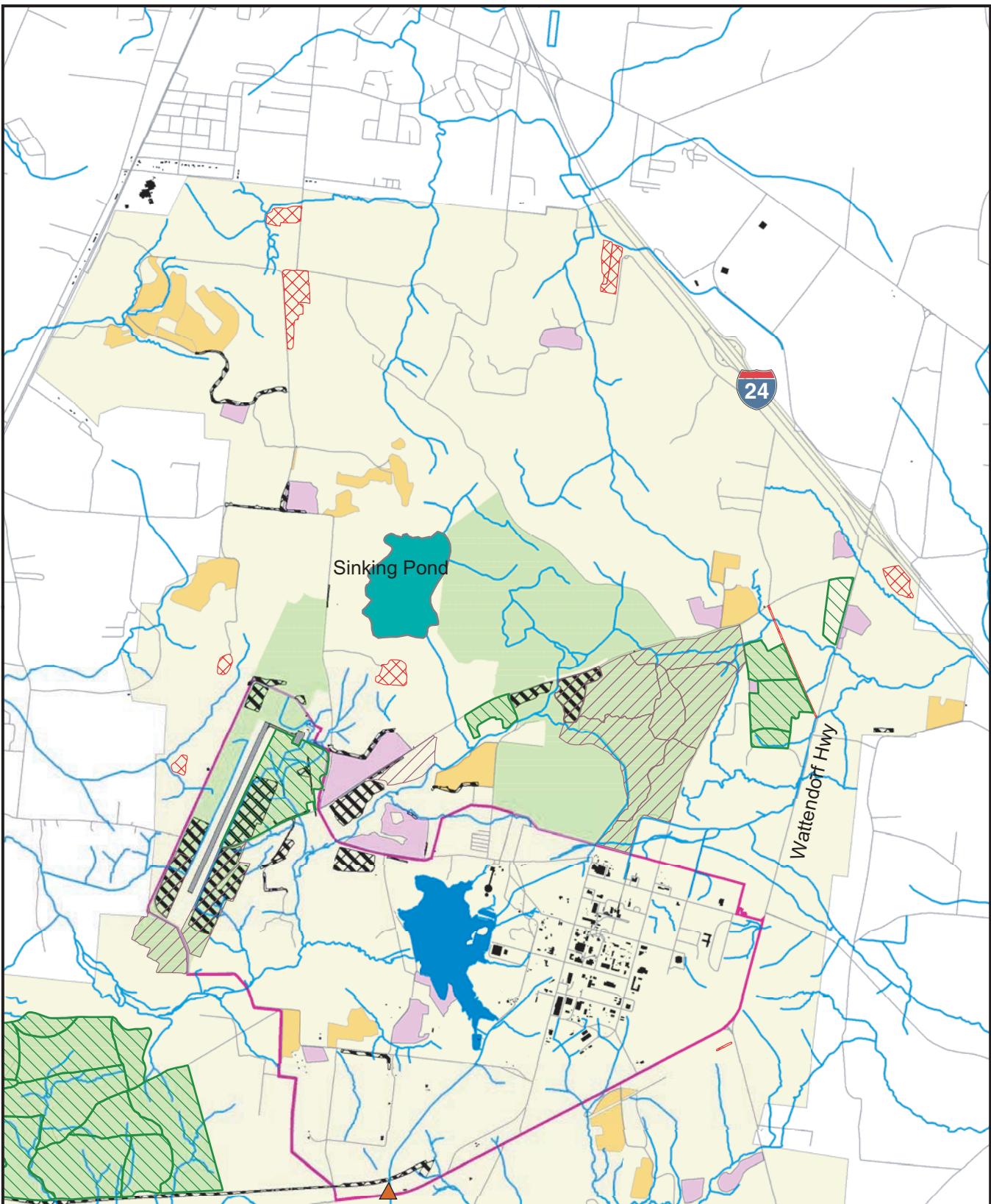


Legend

Barrens Restoration	Road Centerline
TWRA Burn 05-06	Buildings
Proposed Burn 06	Streams
Proposed Burn 05	Arnold AFB Boundary
Barrens Restoration Burn 06	Eggert's Sunflower Occurrences
Barrens Restoration Burn 05	



Figure 4-5
Sensitive Biological Resources and Burn Locations- Western
Prescribed Burn
Final Environmental Assessment



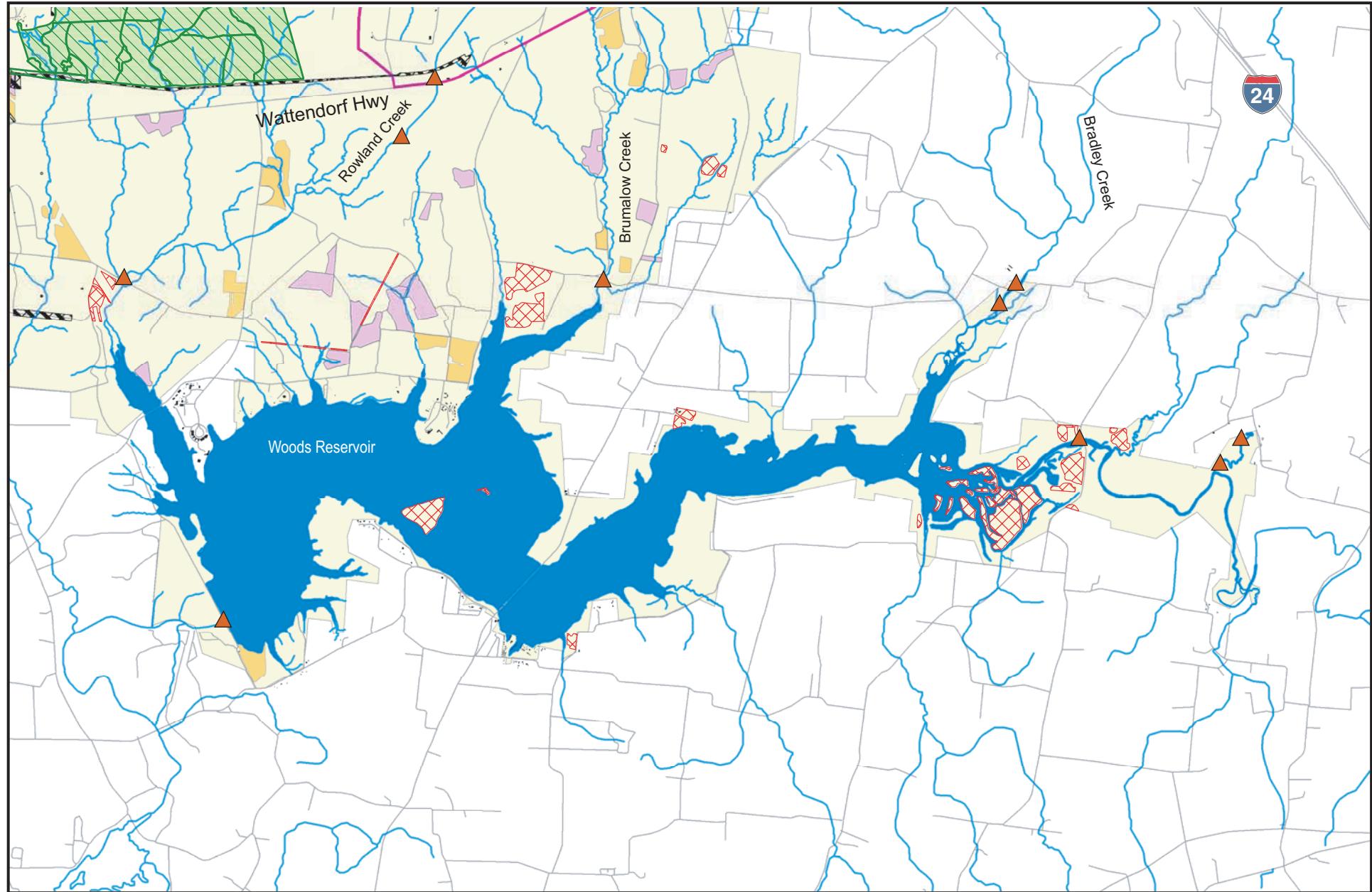
Legend

▲ Gray Bat Occurrences	Streams
☒ Egger's Sunflower Occurrences	— Road Centerline
■ Barrens Restoration	■ Buildings
☒ TVRA Burn 05-06	■ Reservoirs
■ Proposed Burn 05	■ Arnold AFB Boundary
■ Proposed Burn 06	■ AEDC Boundary
■ Barrens Restoration Burn 06	■ Airfield
☒ Barrens Restoration Burn 05	

0 1,250 2,500 Feet



Figure 4-6
Sensitive Biological Resources and Burn Locations - Northern
Prescribed Burn
Final Environmental Assessment



Legend

- Gray Bat Occurrences
- Egger's Sunflower Occurrences
- Barrens Restoration
- TWRA Burn 05-06
- Proposed Burn 06
- Proposed Burn 05
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05

- Streams
- Road Centerline
- Buildings
- Reservoirs
- Arnold AFB Boundary
- AEDC Boundary

0 0.5 1 Miles



Figure 4-7
Sensitive Biological Resources and Burn Locations- Eastern
Prescribed Burn
Final Environmental Assessment

The diet of gray bats consists primarily of aquatic insects. As there would be no impacts to aquatic resources, other than temporary and minor changes in water quality, no impacts to the gray bat prey base would be expected.

No burn sites are proposed near Woods Reservoir Dam, and no impacts to the maternity colony and bachelor colony would be expected.

Indiana Bat

In 2003, AnaBat II™ surveys detected the possible presence of Indiana bats on Arnold AFB (Lamb, 2004b). However, the species has never been captured in mist net surveys on the Base. While the status of Indiana bat occurrence on Arnold AFB is uncertain, it is unlikely that the Proposed Action would impact the species.

No maternity colonies have been found on Arnold AFB and it is unlikely that an undiscovered colony occurs on the Base given the search effort made by the Base. Transient bats roosting in trees would relocate away from the area of the burn until after the fire is over.

Foraging habitat for the Indiana bat could improve following implementation of the prescribed burn program. Indiana bats prefer flying along open corridors, such as firebreaks, to glean prey from the canopy area of adjacent trees (Rommé and Reaves, 1999; USFWS, 1999).

Bald Eagle

The bald eagle has been documented using the area around Woods Reservoir but not in areas proposed for burning. Bald eagles do not nest on Arnold AFB and are capable of leaving the immediate area of a disturbance until it has passed. Therefore, no impacts to bald eagle on Arnold AFB are expected to result from the proposed prescribed burning.

Cumberland Pigtoe

The only impacts to water quality would be temporary and minor, so no impacts to the Cumberland pigtoe would be expected.

Eggert's Sunflower

Eggert's sunflower is widely distributed on Arnold AFB and occurs in areas scheduled for burning (Figures 4-5 through 4-7). The proposed burning would be conducted in accordance with "AEDC Operational Information: Potential Impacts to *Helianthus eggertii*," as discussed above. Procedures outlined in this document, which were developed in conjunction with USFWS, are designed to ensure that activities would not likely adversely affect the species. The proposed prescribed burning activities are consistent with the management procedures developed with USFWS and promote the growth and recovery of the species.

The Proposed Action would reduce habitat competition from other plants and produce conditions more conducive to population expansion. Prescribed burning to restore openings in the Barrens mosaic would provide higher quality habitat for Eggert's sunflower than the more densely canopied forest. However, other environmental variables independent of the Proposed Action, such as extreme drought or severe pest damage, may limit the anticipated benefits.

4.6.2.2 No-Action Alternative

Under the No-Action Alternative no prescribed burns would occur. An absence of prescribed burns would allow development of a more woody plant community through succession, which would reduce the quality of habitat for Eggert's sunflower and other sensitive species associated with the Barrens mosaic. Failure to implement the prescribed burns on the areas designated for Eggert's sunflower would result in Arnold AFB not being consistent with the Cooperative Management Agreement and could result in the need for formal consultation with USFWS.

4.7 Sensitive Habitats

4.7.1 Wetlands

4.7.1.1 Proposed Action

Potential impacts to wetlands were identified in the water quality discussion. Because there would be no more than temporary and minor impacts to water quality, no impacts to wetlands are expected from implementation of the prescribed burning program.

4.7.1.2 No-Action Alternative

Under the No-Action Alternative, no prescribed burning would occur. Therefore, no impacts to wetlands would result from implementation of the No-Action Alternative.

4.7.2 Upland Dry-Mesic Forests and Woodland/Savanna/Grassland

4.7.2.1 Proposed Action

Prescribed burns would be used in upland dry-mesic forests and woodland/savanna/grassland habitats as part of the Barrens restoration effort. Burns in these areas would result in a change in species composition and abundance, but these changes would be desirable and assist in the restoration of the Barrens mosaic on Arnold AFB. The effect would be to benefit overall habitat quality on the Base.

4.7.2.2 No-Action Alternative

Under the No-Action Alternative no prescribed burning would occur. Therefore, no improvement in Barrens habitat would occur and the associated ecological benefits would not be achieved. No other impacts to these habitats would occur under the No-Action Alternative.

4.8 Cultural Resources

Impacts analysis focuses on the potential for the Proposed Actions to affect the quality and utility of significant historical and cultural resources.

4.8.1 Proposed Action

Consultation with the SHPO in 2003 identified all cultural resource sites in pine forests and in most hardwood forests scheduled for restoration as Barrens mosaic on Arnold

AFB. This effort was documented in Archeological Assessment Report No. 300 (R. Alvey, personal communication, 2004).

Areas scheduled for prescribed burn that have not been cleared through SHPO must be investigated prior to the burns. If any sites eligible or potentially eligible for listing on the NRHP are found in these areas, appropriate documentation or recovery, as required by the SHPO, must occur prior to the burn.

If unknown archeological artifacts are discovered in any proposed burn site or firebreak, all activities would halt in the immediate area and the Base would be notified of the finding. At this point, pertinent consultations and follow-on actions would be conducted.

4.8.2 No-Action Alternative

Under the No-Action Alternative, no prescribed burning would occur. Therefore, no impacts to cultural resources would result from implementation of the No-Action Alternative.

4.9 Environmental Restoration Program and Hazardous Materials

4.9.1 Proposed Action

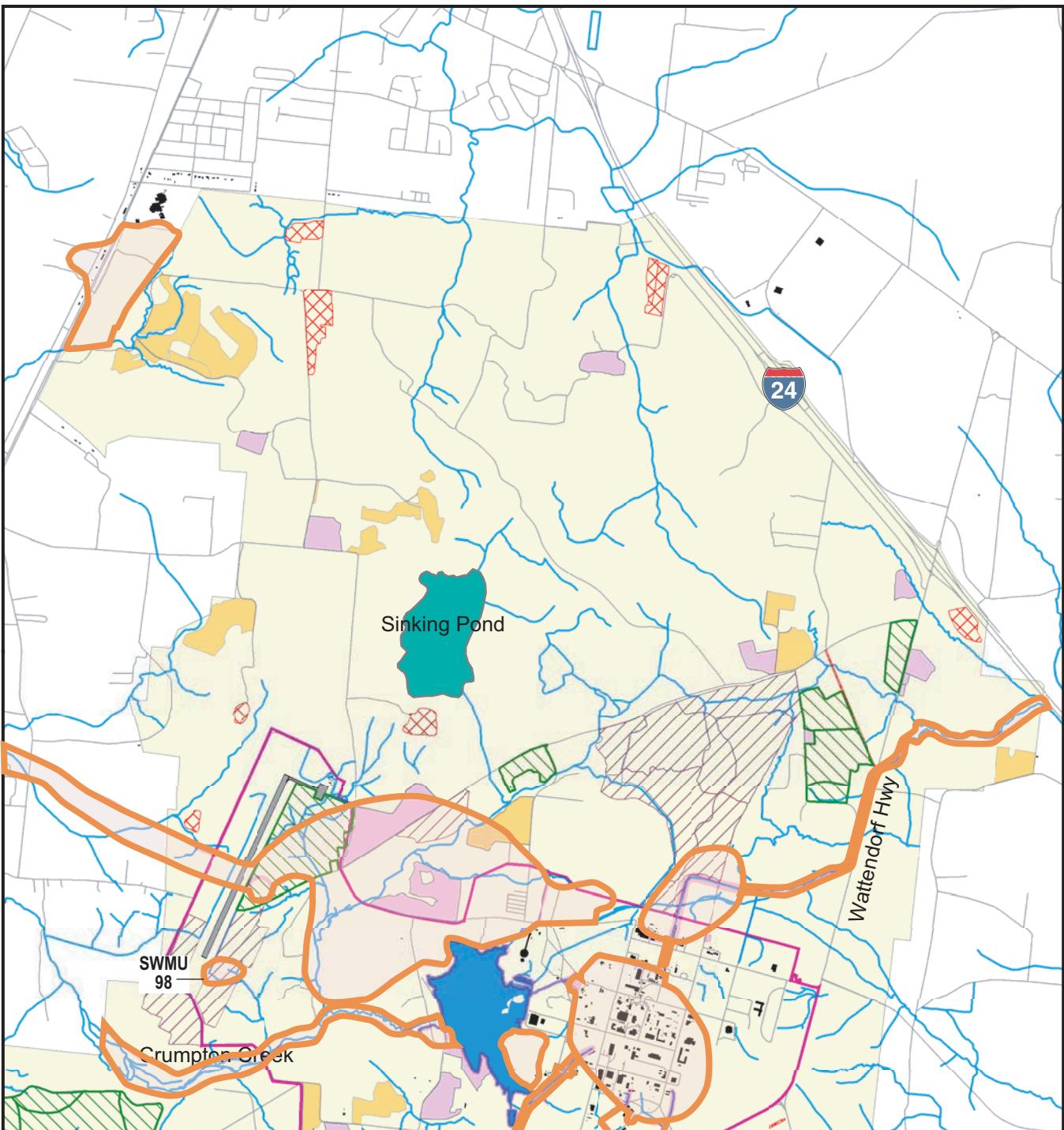
ERP locations at Arnold AFB are shown on Figures 4-8 through 4-10. SWMUs 24 and 98 would be located inside areas identified for prescribed burning activities. The surface soil contamination associated with SWMU 98 has been removed and the site no longer represents a human health or ecological risk. There would be no impact from prescribed burning conducted in this area.

The compounds of concern at the landfill and incinerator sites within SMWU 24 include metals, pesticides, PAHs, PCBs, and dioxins. Depending upon the species of plant, many of these compounds would not likely bioaccumulate in the vegetation from the soils through the roots (Agency for Toxic Substances and Disease Registry [ATSDR], 1995; ATSDR, 2000; Extoxnet, 2005). For other compounds, airborne sources could contribute more to bioaccumulation than the soil concentrations (Rideout et al., 2002). Dioxins present in soils could accumulate to some degree in the associated vegetation; however, this persistence would be generally concentrated in the root and subsurface of the plants. Persistent organic pollutants from ambient air contribute to accumulation in plants, making soil contamination uptake difficult to ascertain (Rappolder et al., 2004). Certain species of plants could hyperaccumulate metals from soils (Lasat, 2005).

Since the potential impacts associated with the incinerator and landfill sites are highly complex and not thoroughly evaluated, those areas would be excluded from the prescribed burning activities.

4.9.2 No-Action Alternative

No ERP sites would be impacted by the No-Action Alternative.

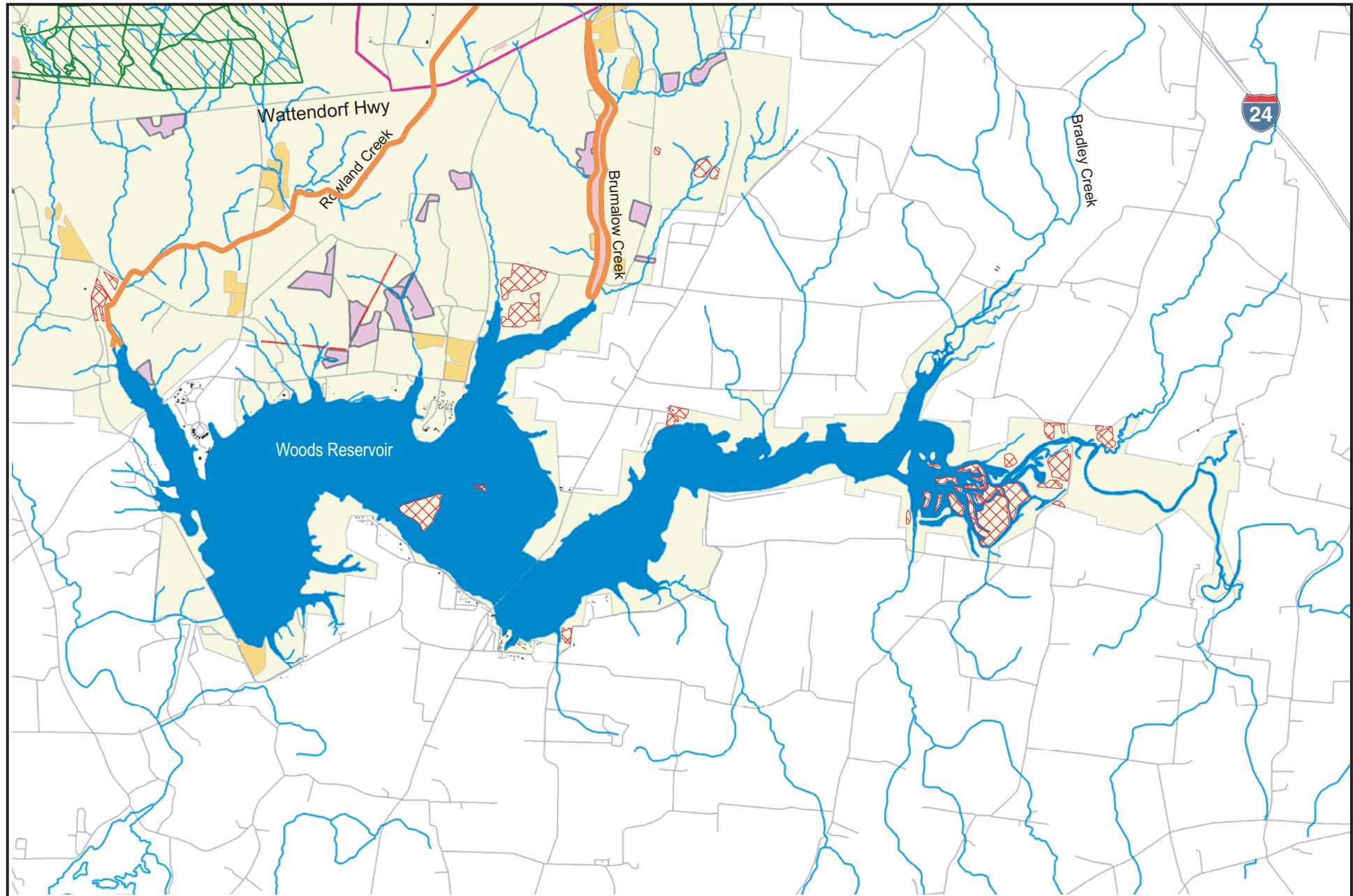


0 1,250 2,500
Feet

- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- Reservoirs
- ERP Sites
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05
- TWRA Burn 05-06
- Proposed Burn 06
- Proposed Burn 05
- Arnold AFB Boundary
- Airfield



Figure 4-8
ERP Sites and Burn Locations - Northern
Prescribed Burn
Final Environmental Assessment

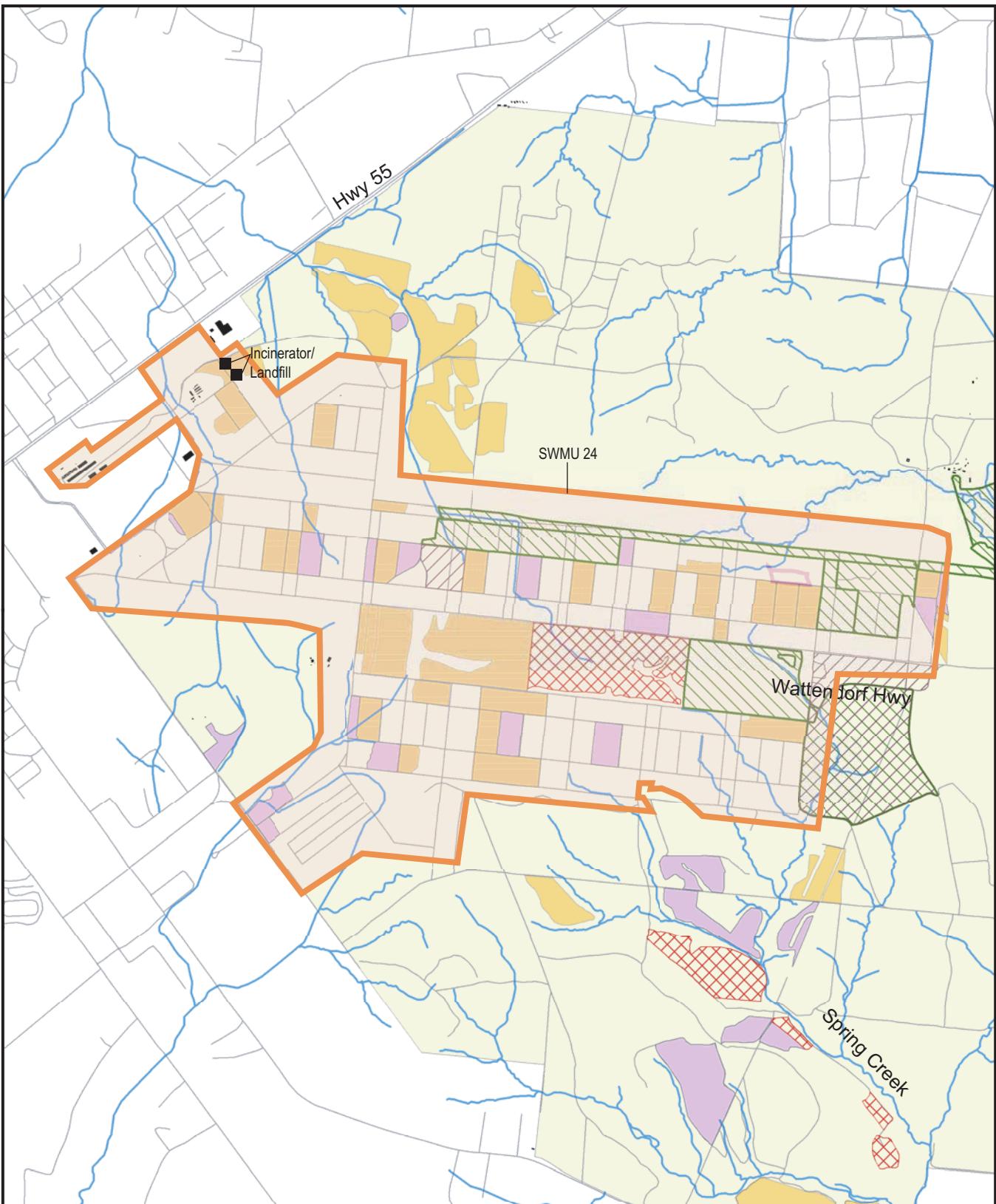


- Proposed Burn 06
- Proposed Burn 05
- AEDC Boundary
- TWRA Burn 05-06
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05
- Streams
- Road Centerline
- Buildings
- Reservoirs
- Arnold AFB Boundary
- ERP Sites

0 1,250 2,500
Feet



Figure 4-9
ERP Sites and Burn Locations - Eastern
 Prescribed Burn
 Final Environmental Assessment



0 1,250 2,500 Feet

- Proposed Burn 06
- Proposed Burn 05
- TWRA Burn 05-06
- Barrens Restoration Burn 06
- Barrens Restoration Burn 05
- Streams
- Road Centerline
- Buildings
- AEDC Boundary
- Arnold AFB Boundary
- ERP Sites



Figure 4-10
ERP Sites and Burn Locations - Western
Prescribed Burn
Final Environmental Assessment

4.10 Cumulative Impacts from Prescribed Burns

4.10.1 Proposed Action

The prescribed burn program is a long-term effort to promote sound timber management on pine MUs and to restore the Barrens mosaic on portions of the Base. Additionally, TWRA burns wildlife food plots yearly to provide desirable foraging conditions for target wildlife species.

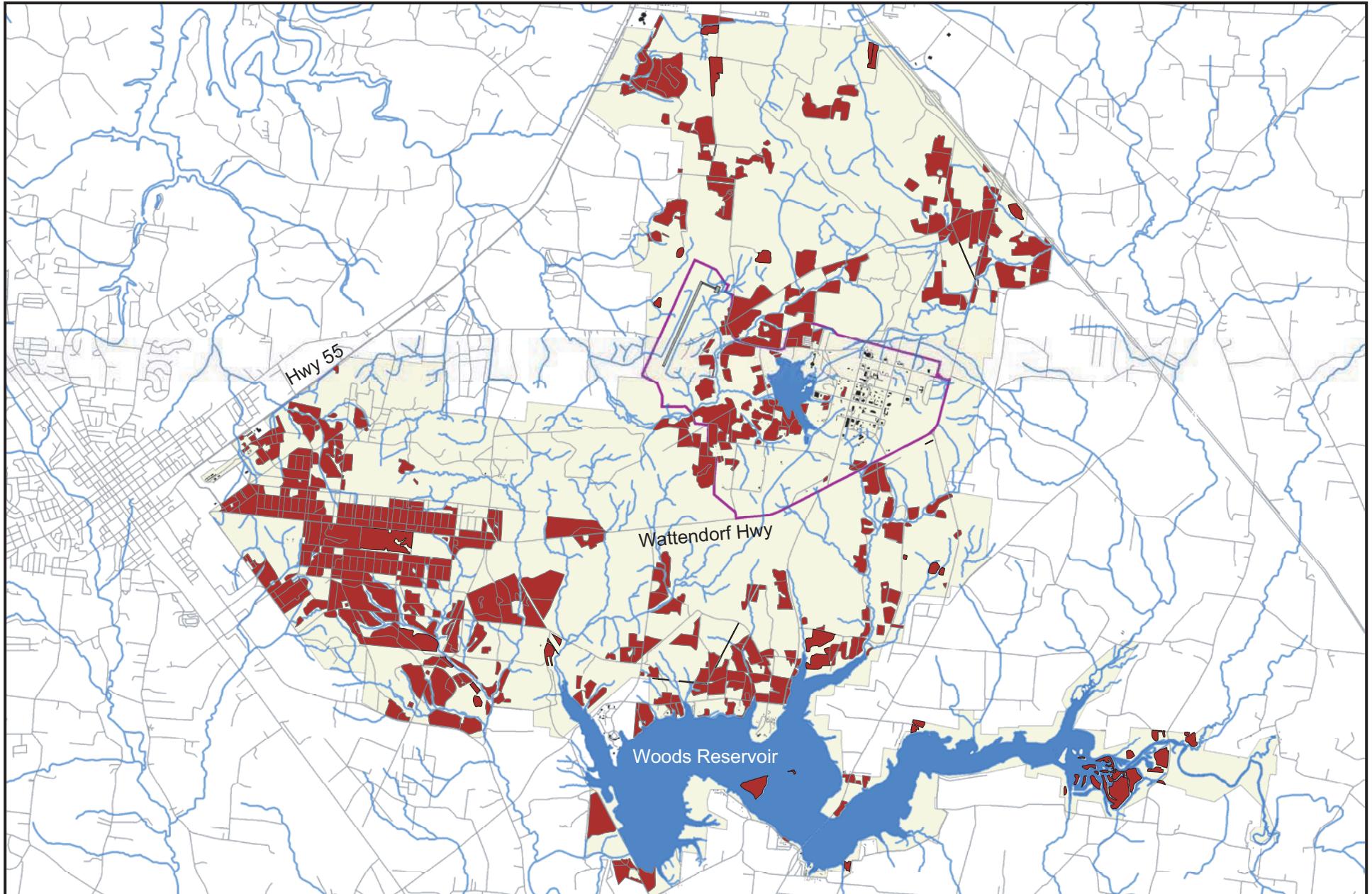
Repeated burning on MUs in the prescribed burn program (Figure 4-11) has the potential to interact with other activities or to have indirect effects not associated with the fire. The use of prescribed burns to restore and maintain the relatively open habitat associated with the Barrens mosaic could result in a reduction of suitable habitat for forest interior songbirds. However, the best habitat for these species is located in the north-central portion of the Base surrounding the Sinking Pond area. This area is not included in the prescribed burn program because a large percentage of the area is wetlands, which makes implementing prescribed burns problematic. Because the prescribed burn program primarily affects areas that are not optimum interior forest songbird habitat, the cumulative impact on these species should be minimal.

There may be a positive impact on interior forest songbirds that utilize pine MUs. Pines develop canopy closure and will support a subset of forest interior songbirds. The closed canopy persists when subjected to a prescribed fire regime, but the burns promote the growth of grasses and other seed-bearing plants in the understory, which are a primary food resource for many of these birds. The increase in food resource associated with increased production in the understory would likely benefit these birds.

In areas that do not support songbirds, increased production of grasses and other plants adapted to open areas, particularly plants in the sunflower family, would result in increased food resources for many passerine birds. Increased food resources could result in increased health and population size for these birds.

Implementation of the prescribed burn program would have a positive impact on vegetation on Arnold AFB. Vegetation changes within areas designated for restoration of the Barrens mosaic are desirable to restore and maintain a habitat type that was historically prevalent in the region and that does not persist in the absence of fire. The frequency of disturbance (e.g., fire, grazing, and mowing) determines the dominance of graminoids and forbs. Continual burning over several years would create conditions favorable for continued recovery of species associated with the Barrens mosaic. Adaptive management would be used to stimulate propagation of big bluestem, little bluestem, Indian grass, and various switch grasses. Annual fires would help control and minimize competitive species and would stimulate additional graminoid and forb community development.

Continual burning over several years would create conditions that are favorable for propagation of big bluestem, little bluestem, Indian grass, various switch grasses and panicums, eupatorium, and occasional rare coastal plain and prairie disjuncts (Call, 2003).



Legend

- MUs in Burn Management
- AEDC Boundary
- Arnold AFB Boundary
- Airfield

- Streams
- Road Centerline
- Buildings
- Reservoirs

0 0.5 1 Miles



Figure 4-11
Management Units on Arnold Air Force Base in Prescribed Burn Management
Prescribed Burn
Final Environmental Assessment

Timber management on Arnold AFB would benefit from the prescribed burn program. Pine MUs, for example, would benefit from a regular fire regime. Fire would reduce or exclude competition from hardwood species, allowing greater growth of pine timber.

4.10.2 No-Action Alternative

As discussed above, the No-Action Alternative would have long-term deleterious impacts on restoration of the Barrens mosaic. Fire exclusion in the areas designated for Barrens restoration allows dense canopies of woody vegetation to develop and exclude the Barrens species that are adapted to more open conditions.

Not implementing the prescribed burn program would likely result in accumulation of an excessive fuel load on the forest floor. A high fuel load is susceptible to catastrophic fire events, which would destroy timber value and wildlife habitat, and could result in threats to the local human population.

5.0 Plan, Permit, and Management Requirements

The Proposed Action, as described, would not require CWA Section 404 permitting or permitting under the TWQCA.

Coordination with the SHPO would be required if surveys in the hardwood tracts that have not been surveyed previously identify any site potentially eligible for listing on the NRHP. All other proposed prescribed burn areas (pine forests and other Barrens restoration areas) have been surveyed and additional coordination with the SHPO would not be required to conduct prescribed burns in these areas.

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8.0 References

ATA Conservation. 2004a. Two-Year Forest Management Plan 2005-2006. Environmental Management, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

ATA Conservation. 2004b. Two-Year Conservation Management Plan 2005-2006. Environmental Management, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

ATSDR. 2000. Toxicological profile for polychlorinated biphenyls. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

ATSDR. 1995. Toxicological profile for polycyclic aromatic hydrocarbons. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Aycock, R. A., and Haugh, C. J., 1999, Ground-Water Hydrology and Water-Quality Data for Wells, Springs, and Surface-Water Sites in the Bradley-Brumalow Creeks Area near Arnold Air Force Base, Tennessee, September to December 1999, U. S. Geological Survey Open-File Report 01-40, 49 p.

Brown, J.K. 2000. Introduction and Fire Regimes. Chapter 1 in Wildland Fire in Ecosystems: Effects of Fire on Flora; J.K. Brown and J.K. Smith, editors. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-42, Volume 2.

Call, G. 2003. Integrated Ecosystem Management Plan - Protecting, restoring, and managing using the principles of Ecosystem Management. Arnold Engineering Development Center, Arnold Air Force Base, Tennessee. ACS, Environmental Services, Conservation. September 2003.

Carver, B.D., J. W. Lamb, L Jennings, R. Moore, and G. West. 1998. Great blue heron colony status and nest site characteristics at Sinking Pond, Tennessee. *The Migrant* 69(4): 176-178.

CH2M HILL. 2001. SWMU Assessment Reports, Camp Forrest Area Arnold AFB. Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

CH2M HILL. 2002. Land Use Characterization: Final Report. Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

CH2M HILL. 2004. RCRA Facility Investigation Supplement SWMU 98. Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Douglass, J.E.; D.H. Van Lear., 1982. Prescribed burning and water quality of ephemeral streams in the Piedmont of South Carolina. *Forest Science* 29:181-189.

Extoxnet. Extension Toxicology Network. <http://extoxnet.orst.edu/pips/ddt.htm>. Accessed 17 January 2005.

Fitch, K. 2003. Eggert's Sunflower Management Plan for Arnold Air Force Base. Environmental Management, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Hajic, E., W.J. Bennett, Jr., W. Isenberger, J. Northrip, and R. Bennett. 2002. Draft Report: Archeological Site Evaluation - Native American. Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Haugh, C. J., 1996, Hydrology of the area near the J4 test cell, Arnold Air Force Base, Tennessee: U.S. Geological Survey Water-Resources Investigations Report 96-4182, 43 p.

Haugh, C. J., and E. N. Mahoney. Hydrogeology and simulation of ground-water flow at Arnold Air Force Base, Coffee and Franklin Counties, Tennessee: U.S. Geological Survey Water-Resources Investigations Report 93-4207. 1994.

Huff, M.H. and J.K. Smith. 2000. Fire Effects on Animal Communities. Chapter 5 in Wildland Fire in Ecosystems: Effects of Fire on Fauna; J.K. Smith, editor. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-42, Volume 1.

Lamb, J.W. Annual Report For Partners In Flight Point Counts (A.3018) Arnold Air Force Base/Arnold Engineering Development Center (AEDC). Technical report prepared for Arnold Engineering Development Center. 1999.

Lamb, J.W. Annual Report For Partners In Flight Point Counts (A.3018) Arnold Air Force Base/Arnold Engineering Development Center (AEDC). Technical report prepared for Arnold Engineering Development Center. 2000.

Lamb, J.W. Annual Report for Partners In Flight Point Counts (A.3018) Arnold Air Force Base/Arnold Engineering Development Center (AEDC). Technical report prepared for Arnold Engineering Development Center. 2001.

Lamb, J.W. Annual Report For Partners In Flight Point Counts (A.3018) Arnold Air Force Base/Arnold Engineering Development Center (AEDC). Technical report prepared for Arnold Engineering Development Center. 2002.

Lamb, J.W. Annual Report For Partners In Flight Point Counts (A.3018) Arnold Air Miller, R.A., 1974, The geologic history of Tennessee, Tennessee Division of Geology Bulletin 74, 63 p. 2003a.

Lamb, J.W. Gray Bat Management Plan for Arnold Air Force Base. Environmental Management, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee. 2003b.

Lamb, J.W. 2004a. Annual Report For Partners In Flight Point Counts (A.3018) Arnold Air Force Base/Arnold Engineering Development Center (AEDC). Technical report prepared for Arnold Engineering Development Center.

Lamb, J.W. 2004b. Baseline bat fauna inventory final report. Technical report prepared for Arnold Engineering Development Center.

Lasat, Mitch. 2005. The use of plants for the removal of toxic metals from contaminated soil. American Association for the Advancement of Science. Environmental science and engineering fellow. <http://clu-in.org/download/remed/lasat.pdf>. Accessed 18 January 2005.

Love, T., L. D. Williams, W. H. Proffitt, I. B. Epley, and J. Elder. Soil Survey of Coffee County, Tennessee: U.S. Department of Agriculture, Soil Conservation Service, Series 1956, No. 5, 112 pp. 1959.

Lyon, J.L., E.S. Telfer, and D.S. Schreiner. 2004. Direct Effects of Fire and Animal Responses. Chapter 3 in Wildland Fire in Ecosystems: Effects of Fire on Fauna; J.K. Smith, editor. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-42, Volume 1.

McNab, W.H. and P.E. Avers. 1994. *Ecological Subregions of the United States*. Prepared in cooperation with Regional Compilers and the ECOMAP Team of the Forest Service. <http://www.fs.fed.us/land/pubs/ecoregions/index.html>

Miller, R.A., 1974, The geologic history of Tennessee, Tennessee Division of Geology Bulletin 74, 63 p.

Mullen, D., B. Miller, B. Cushing, J. Williams. 1995. An investigation and assessment of rare, threatened, and endangered fauna and their habitats on Arnold Air Force Base: invertebrates, fish, amphibians, reptiles, mammals, and birds. Technical report prepared for Arnold Engineering Development Center.

Murphy, T.M., F.M. Bagley, W. Dubuc, D. Mager, S.A. Nesbitt, W.B. Robertson, and B. Sanders. 1989. *The Southeastern States Bald Eagle Recovery Plan – Revision*. Region Four U.S. Fish and Wildlife Service, Atlanta Georgia.

Patterson, W. B. Vegetation and Soils of the Sinking Pond Area, Coffee County, Tennessee: Knoxville, University of Tennessee, M.S. Thesis, 105 pp. 1989.

Peyton, P.M. 2004a. Preliminary Draft report: Historic Building and Associated Landscape Inventory and Evaluation, Arnold Air Force Base, Tennessee. Volume I. Prepared for the United States Air Force AEDC/SDE, Arnold AFB, Tennessee.

Peyton, P.M. 2004b. Preliminary Draft report: Historic Building and Associated Landscape Inventory and Evaluation, Arnold Air Force Base, Tennessee. Volume II. Prepared for the United States Air Force AEDC/SDE, Arnold AFB, Tennessee.

Pullin, P. P. 1980. Nest distribution the sinking pond colony. A report to the Tennessee Valley Authority.

Pullin, P. P. 1990. Size and trends of wading bird populations in Tennessee during 1977-1988. *The Migrant* 61(4): 95-104.

Rappolder M., C. Schroeter-Kermani, U. Waller, W. Koerner. Retrospective Monitoring of PCDDs, PCDFs, and PCBs in Pine- and Spruce-Shoots – Results from the German

Environmental Specimen Bank. Dioxin Symposium 2004. Website:
<http://dioxin2004.abstract-management.de/overview/s120.htm>. Accessed 17 January 2004.

Rideout, K., K. Teschke, S. Varughese. Potential for Exposure to Polychlorinated Dibenzo-p-dioxins and Dibenzofurans when Recycling Sewage Biosolids on Agricultural Land. British Columbia Ministry of Water, Land and Air Protection, Environment, Canada. 2002.

Roberts, T.H., M.S. Peterson, and CH2M HILL. 2001. Wetland fauna and drainage basin studies: spatial aspects of habitat use by birds in and around forested depressional and flats wetlands. Prepared for Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Rommé, R.C. and R.P. Reaves. 1999. Fort Leonard Wood Endangered Species Management Plan for the Indiana Bat (*Myotis sodalis*), Gray Bat (*Myotis grisescens*), and Bald Eagle (*Haliaeetus leucocephalus*). Directorate of Public Works, Fort Leonard Wood Energy, Environment and Natural Resources Division.

Smalley, G.W. 1983. Classification and Evaluation of Forest Sites on the Eastern Highland Rim and Pennyroyal: New Orleans, USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-43, 123 pp.

Springer, M. E. and J. A. Elder. 1980. Soils of Tennessee: University of Tennessee Agricultural Experiment Station Bulletin 586.

Strohmeier, C. 2003a. Arnold Air Force Base Barrens Management Plan Annual Update. Environmental Management, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Strohmeier, C. 2003b. Arnold Air Force Base Fire Management Plan 2003, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

Tennessee Department of Agriculture Division of Forestry. 2003. *Guide to Forestry Best Management Practices*. <http://www.state.tn.us/agriculture/forestry/bmpmanual.html>.

Tennessee Department of Environment and Conservation, Division of Water Supply. 2002a. Tennessee Ground Water Report, 305b Water Quality Report, November 2002.

Tennessee Department of Environment and Conservation (TDEC). 2002b. 2002 305(b) Report: The Status of Water Quality in Tennessee. <http://www.state.tn.us/environment/water.php>.

Tennessee Wildlife Resources Agency (TWRA). 2004a. Eagle Count Scheduled for January. <http://www.state.tn.us/twra/eaglecount.html>.

Tennessee Department of Environment and Conservation (TDEC) Natural Heritage Website. 2004b Rare and Endangered Vascular Plant List of Tennessee. <http://www.state.tn.us/environment/nh/tnplants.php?type=vasc>, 2004.

Tennessee Department of Environment and Conservation (TDEC) Natural Heritage Website. 2004c. Rare and Endangered Vertebrate List of Tennessee. <http://www.state.tn.us/environment/nh/tnanimals.php>, 2004.

Tennessee Department of Environment and Conservation (TDEC) Natural Heritage Website. 2004d. Rare and Endangered Invertebrate List of Tennessee. <http://www.state.tn.us/environment/nh/tninvert.php>, 2004.

TRC Garrow Associates, Inc., M.T. Cleveland, and J.L. Holland. 2001. *Historic Building Survey and Evaluation, Arnold Air Force Base, Coffee and Franklin Counties, Tennessee, Draft Report*. Prepared for Arnold Engineering Development Center, Arnold Air Force Base, Tennessee.

USDA Soil Conservation Service (SCS). 1949. Soil Survey Series of Franklin County, Tennessee. In cooperation with Tennessee Agricultural Experiment Station Tennessee Valley Authority.

USEPA. 2004. Section 303(d) List Fact Sheet for Watershed Upper Elk. February 2004. http://oaspub.epa.gov/pls/tmdl/huc_rept.control?p_huc=06030003&p_huc_desc=UPPER%20ELK

US Fish and Wildlife Service (USFWS). 1999. Agency Draft Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. Fort Snelling, Minnesota. 53 pp.

Wade, D.D, B.L. Brock, P.H. Brose, J.B. Grace, G.A. Hoch, and W.A. Peterson III. 2000. Fire in Eastern Ecosystems. Chapter 4 in Wildland Fire in Ecosystems: Effects of Fire on Flora; J.K. Brown and J.K. Smith, editors. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-42, Volume 2.

Whitaker, J.O., Jr. and W.H. Hamilton, Jr. 1998. Mammals of the Eastern United States. Comstock Publishing Associates. Ithaca, New York. 583 pp.

White, D. L. and J. A. Ratzlaff. 2000. Recovery plan for *Helianthus eggertii* Small (Eggert's sunflower). Region 4, U. S. Fish and Wildlife Service, Atlanta, Georgia.

Wilson, C. W., 1976, Geologic map and mineral resources summary of the Manchester quadrangle, Tennessee Division of Geology, MRS 86-NE, scale 1:24,000.

Appendix A

Air Force Form 813

Environmental Impact Analysis: 000186 - Conservation prescribed burning program**From:**Mark Moran**Proponent Org:**ATA/SS43**Project:**P00003452**Purpose And Need:** Request approval for the ecological and pine forest prescribed burning activities supporting the Integrated Ecosystem Management Plan for Arnold AFB.**Description And Alternative:** See attached document**Air Installation Compatable Impact:** No Effect **Status:**Closed**Air Quality Impact:** No Effect **Status:**Closed**Water Resources Impact:** No Effect **Status:**Closed**Safety And Occupational Health Impact:** No Effect **Status:**Closed **Description:** Follow safe work practices per OSHA, EPA and Air Force standards.**Hazardous Materials Impact:** No Effect **Status:**Closed**Hazardous Waste Impact:** No Effect **Status:**Closed**Biological Resources Impact:** Positive Effect **Status:**Closed **Description:** Overall impact of this program should be positive in that damage in case of wildfire will be lessened and desirable habitats will be promoted. During the preparation and burning activities, the guides established in the Burn Management Plan should be strictly adhered to and Best Management Practices established by the state of Tennessee should be implemented.**Cultural Resources Impact:** Unknown Effect **Status:**Open **Description:** The pine stands were subjected to a SHPO review in 2003 which identified three archaeological sites to be avoided. If these sites are adequately marked and avoided then no further work is needed for pine plantations. Ecological areas receiving control burns will need a Section 106 consultation accomplished.**Geology And Soils Impact:** No Effect **Status:**Closed**Socioeconomic Impact:** No Effect **Status:**Closed**Installation Restoration Program Impact:** Unknown Effect **Status:**Closed **Description:** Location of stands not provided. Need to determine whether burns will occur on IRP sites**Other Impacts:****Remarks:** Customer Need Date: 01-Oct-04**Determination:** Further Environmental Analysis Required**Determination Justification:****AF 3 Letter Approval Signature** ---- Richard McWhite **Comments** ---- Customer Need Date is 1 Oct. 04.**Environmental Planning Approval Signature** ---- Philip Sherrill **Comments** ----**Environmental Final Approval Signature** ---- Philip Sherrill **Comments** ----**Media Management Approval Signature** ---- Pam King **Comments** ----**EIAP Approval Signature** ---- Richard McWhite **Comments** ---- EA required- two open actions.**SDE Director Approval Signature** ---- Frank Duncan **Comments** ----

AF-813 Attachment

Purpose of and Need for Action:

Request for approval of ecological and forest management prescribed burning activities supporting the Integrated Ecosystem Management Plan for AEDC.

Description of Proposed Action and Alternatives:

Proposed Action: Prescribed burning for ecological restoration and forest management on Arnold AFB.

The prescribed burning activities on Arnold AFB consist of the following:

- Prescribed burning
- Firebreak maintenance
- Site protection to reduce/eliminate soil erosion

Prescribed burning activities are accomplished in order to improve wildlife habitat, reduce hardwood competition in pine plantations, reduce the amount of available fuels in case of wildfire, and ecological restoration and maintenance. The prescribed burn is accomplished by installing and /or maintaining firebreaks around the site to be burned. The site is then ignited using the technique most appropriate for the fuel type and weather conditions.

Justification

Prescribed burns are necessary to implement the Integrated Ecosystem Management Plan (IEMP) for AEDC. The IEMP describes the historic importance of fire in shaping the ecological communities of the Barrens region where the base is located. The IEMP also describes the importance of the pine forest and the role that fire plays in maintaining this resource. The plan also describes Site Conservation Planning (SCP), which is the framework used at AEDC for translating general principles of ecosystem management into on-the-ground management. In 1999, AAFB adopted the Site Conservation Planning (SCP) process as a tool for transferring the science-based, adaptive framework of ecosystem management into a clear set of goals and strategies for the base's conservation program. Central to SCP was the selection of the following focal conservation targets:

- Barrens mosaic
- Karst wetlands
- Streams and springs
- Gray bat

The first three focal targets are ecological systems that occur together in the landscape and are linked by ecological processes and environmental gradients. Fire influences composition, structure, and function in all of these ecological systems, but is probably most influential in the Barrens mosaic. "Altered (vegetation) composition and structure" was identified during SCP as a high-level active stress to the Barrens mosaic. Wildfire

suppression and limited application of prescribed fire on the Barrens landscape are the sources of this ecosystem stress. This situation has effectively removed a fundamental ecological process from this focal conservation target.

Restoring fire as a formative process in management units encompassing the three ecological systems listed above is a high-priority ecosystem management strategy for AEDC. AEDC's Barrens Management Plan directs the use of prescribed burning and other tools for ecological restoration and maintenance on approximately 3,500 acres during FY03 – FY08. The base's Eggert's Sunflower Management Plan calls for prescribed burning in approximately 240 acres to support recovery goals established by the US Fish and Wildlife Service (USFWS), who approved the plan through informal Section 7 consultation under the Endangered Species Act.

Prescribed burning at a rate of 1,000 acres per year will maintain a five-year burning cycle in the pine forests. This cycle is necessary to keep the level of forest fuels low level to prevent forest resources damage in the event of wildfire.

The maintenance of firebreaks is accomplished in conjunction with the prescribed burning program. Firebreak maintenance is accomplished using several methods:

- Removal of debris by hand
- Removal of light brush by cutting with chainsaw
- Light grading with dozer to remove heavy vegetation and/or large debris from the firebreak and spreading the graded material back over the firebreak upon completion of the burning

Prescribed Burn Plans

Implementing prescribed burns requires considerable planning and coordination of personnel from various installation support services organizations. A prescribed burn plan is developed for each burn unit that identifies the objectives for the prescribed burn; lists potential risks associated with topography, fuels, or surrounding context for the unit; and stipulates the required personnel, weather conditions, and ignition and smoke management strategies for conducting a safe and effective burn.

General objectives for prescribed burning stated in AEDC's Fire Management Plan are listed below:

1. Reintroduce fire as an ecological process over the AAFB landscape, including the Barrens mosaic, karst wetlands, and springs and streams, permitting it to burn over a wide range of vegetation types, soils and hydrology on AAFB
1. Use fire to change oak-dominated forests to oak-dominated woodlands and savannas, and shrub-grasslands

2. Use fire to maintain existing grasslands, shrub-grasslands, and oak dominated woodlands and savannas.
3. Use fire to restore and maintain habitats for rare, threatened, and endangered plant and animal species.
4. Use fire to maintain open and semi-open conditions for base operational and military training purposes.
5. Use fire to reduce hardwood competition, improve habitat for a variety of wildlife species, and to reduce fuel loads in pine plantations.
6. Use fire to promote habitat for wildlife management, primarily for game species such as deer, turkey, and quail, especially in management areas supporting native warm season grasses.

AEDC's Fire Management Plan also provides general weather and fuel condition guidelines (see table) that are refined for individual prescribed burns, as documented in prescribed burn plans.

General weather and fuel condition guidelines that are refined in individual burn prescriptions (excerpt from AEDC Fire Management Plan).

Weather	Guideline
Temperature	40 - 85° F
Relative Humidity	25 - 65%
Mid-Flame Wind Speed	1 - 6 mph
20-ft. Wind Speed	3 - 20 mph
Cloud Cover	0 - 100%
Mixing Height	> 1700 ft.
Transport Speed	≥ 9 mph
Days Since Rain	≥ 2 (Non-grass fuels); ≥ 1 (Grass fuels)
Fuel	
1-Hr. Time Lag Fuel Moisture	4 - 12%
10-Hr. Time Lag Fuel Moisture	8 - 20%
100-Hr. Time Lag Fuel Moisture	>8%

Smoke Management

Smoke management is a primary concern of prescribed burn practitioners. Unlike smoke from wildfire, which can be controlled only by suppressing the fire, smoke from prescribed fire can be managed to a certain degree. Fuels and weather conditions determine the amount of smoke created, the direction it travels, and its mixing height.

The greatest threat to public safety relates to smoke-reduced visibility on the highways. The second greatest concern is for wildfires spreading into lands adjacent to AAFB or causing harm to life or properties at AAFB due to extreme weather or fuel conditions. Prescribed fire has the potential of creating hazardous smoke conditions on roads, the AEDC Industrial Area, and adjacent residential areas. Such hazards can be minimized by using good judgment, monitoring weather and other environmental conditions, and adhering to accepted smoke management guidelines.

The following guidelines will be used to reduce smoke-related impacts when planning and conducting prescribed fires on AAFB:

1. Consider the impact of smoke on the overall environment when planning and prescribing fire to management units.
2. Obtain and use fire weather forecasts, including wind speed and direction and mixing height.
3. Do not burn during pollution episodes or when temperature inversions exist or are likely to exist.

4. Burn when conditions encourage rapid dispersion.
5. Notify the local forestry office for burn permits and immediate adjacent landowners (both required by law).
6. Burn under favorable moisture conditions.
7. Use backing fires when applicable for reduced emissions.
8. Burn large areas when weather conditions are ideal for rapid smoke dispersion.
9. Burn out and start mop-up as soon as possible to reduce impacts of residual smoke on visibility and health.
10. Be cautious when burning at night, when smoke may stay near the surface, or when inversions may take place.
11. Have an emergency plan in place to
 - a. control traffic on nearby roads
 - b. Stop the prescribed fire if it is not burning according to plan or if weather conditions change.
12. Use rake-type blades during silvicultural site preparation activities to minimize smoke emissions by keeping soil out of dozer piles and windrows.

Job Safety Analysis for Prescribed Fire

Job Safety Analyses (JSAs) are prepared for all operational activities on the base. The JSA is a documented process where tasks are outlined in a step-wise fashion. Actual or predicted hazards of each step are defined in writing on a job safety analysis worksheet and are followed by the required controls and precautions for eliminating or reducing the listed hazards for the job. The JSA is continually updated to reflect changes in hazards identified and responses to those hazards. Before any job or task begins, the JSA for that particular endeavor is communicated to the personnel assigned to that job. Each individual must sign the appropriate JSA prior to working on any job. The signature is an acknowledgement the employee has read and understands the JSA.

A JSA has been developed for prescribed fire operations at AAFB (Appendix A). Personnel participating on each prescribed burn must first read and sign the prescribed burning JSA. Separate JSAs have been prepared for common activities that are part of prescribed burning, specifically, chainsaw use and loading, transporting, and unloading heavy equipment. These JSAs must be reviewed and signed by the appropriate personnel on prescribed fires when these activities are anticipated. All burn personnel review and sign JSAs during review of the prescribed burn plan Fire Safety Guidelines section.

Alternative Action: The alternative action would be to not conduct prescribed burns for ecological restoration at AAFB. Selecting this alternative would prohibit the Conservation program from implementing strategies outlined in AEDC's IEMP. This alternative would lead to continued alteration of composition and structure in the Barrens on AAFB. This ecosystem stress would, in turn, negatively affect numerous rare species and communities identified in the IEMP. Inability to conduct prescribed burns also would prevent AEDC from implementing measures outlined in AEDC's Eggert's Sunflower Management Plan. Departing from this plan would necessitate reinitiating informal Section 7 consultation with the US Fish and Wildlife Service to develop alternative habitat management strategies for this species.

Appendix B

Fire Management Objectives and Strategies for Each Fire Management Unit on Arnold AFB

TABLE B-1

Fire Management Objectives and Strategies for Each Fire Management Unit on Arnold AFB
Prescribed Burn Final Environmental Assessment

Fire Management Unit (FMU)	Wildfire Suppression Objectives	Wildfire Suppression Strategies	Prescribed Burn Objectives	Prescribed Burn Strategies
FMU-1	<ul style="list-style-type: none"> 1. Minimize fire size, damage, and risk. 2. Protect all values at risk. 3. Confine fire within compartment area, including the security fence within Compartment 10. 4. Take measures to protect motorists on Wattendorf Highway. 	<ul style="list-style-type: none"> 1. Use direct attack when suppressing fire in FMU-1 if roads or other man-made or natural breaks are not close by. 2. Use indirect attack when suppressing fire at Arnold Airfield unless lives or structures are at risk or if aircraft are using the airfield. 3. Monitor for spot fires across roads, firelines, and especially the security fence. 	<ul style="list-style-type: none"> 1. Conduct ecological burns to maintain ROW for Arnold Airfield and Barrens restoration, and to maintain habitat for Henslow's sparrow. Burn on a 3-year rotation. 2. Burn pine plantations on a 5-year rotation for multiple benefits. 	<ul style="list-style-type: none"> 1. Use existing roads, natural barriers, wetlines, and existing mechanically constructed firelines where practical. Limit construction of new mechanical firelines. 2. Conduct prescribed burns when smoke would blow away from residences, main roads and the AEDC Industrial Area. Notify Operations before burning near Arnold Airfield.
FMU-2	<ul style="list-style-type: none"> 1. Protect adjacent residences, structures, and other improvements outside the Base. 2. Protect all resources within the Base. 3. Take measures to protect motorists on Wattendorf Highway, Highways 55 and 127, Interstate 24, Harton Boulevard, and Spring Creek Road. 	<ul style="list-style-type: none"> 1. Use direct attack when life or property are imminently threatened by fire and/or smoke. 2. Use indirect attack if weather is extreme or if fire behavior becomes extreme. 3. Confine all other fires to existing roads and other man-made and natural breaks using indirect attack and limited mechanical line construction. 	<ul style="list-style-type: none"> 1. Conduct ecological burns for Barrens restoration and habitat maintenance for Eggert's sunflower and Henslow's sparrow. Burns are to be conducted at 1- to 5-year intervals, depending upon FMU objectives. 2. Burn pine plantations on a 5-year rotation for multiple benefits. Site preparation burns are allowed over most areas. 	<ul style="list-style-type: none"> 1. Use existing roads, natural barriers, handlines, wetlines, and existing mechanical blade lines where possible. Construct the minimum amount of new mechanical firelines for burn units. 2. Burn only when favorable wind conditions exist to keep smoke off main highways.

TABLE B-1

Fire Management Objectives and Strategies for Each Fire Management Unit on Arnold AFB
Prescribed Burn Final Environmental Assessment

Fire Management Unit (FMU)	Wildfire Suppression Objectives	Wildfire Suppression Strategies	Prescribed Burn Objectives	Prescribed Burn Strategies
FMU-3	<ul style="list-style-type: none"> 1. Confine fires to existing blocks created by roads and other man-made barriers. 2. Take measures to protect motorists along Interstate 24 and Wattendorf Highway. 	<ul style="list-style-type: none"> 1. Utilize roads and other man-made barriers as potential control lines 2. Monitor fire behavior and smoke movement to ensure life and property are not threatened. 3. When conditions permit, allow fires to burn into and self-extinguish in swamp forests rather than using direct or indirect attack. 4. Patrol areas adjacent to the FMU perimeter for spot fires across control lines. 5. Use direct attack only if life or property are imminently threatened. 	<ul style="list-style-type: none"> 1. Conduct large prescribed burns for Barrens restoration, permitting fire to burn over a wide range of soil types, vegetation types, and hydrologic conditions. 2. Burn pine plantations on a 5-year rotation for multiple benefits. Site preparation burns are allowed over all areas. 	<ul style="list-style-type: none"> 1. Continue to develop large burn units utilizing roads and other man-made barriers and swamp forests as firebreaks.

Appendix C

Job Safety Analysis for Prescribed Burning

PROJECT NAME		LOCATION	WORK ORDER NO.			
<u>Prescribed Burning</u>						
1. WRITE JOB/TASK IN THE SPACE PROVIDED AND DIVIDE THE TASK INTO INDIVIDUAL STEPS, AS APPROPRIATE. 2. IN THE HAZARD COLUMN, LIST ALL POSSIBLE HAZARDS ANTICIPATED IN THE INDIVIDUAL STEP OF THE TASK OR JOB 3. IN THE SAFE PLAN COLUMN, PROVIDE THE CORRECTIVE ACTIONS THAT WILL BE TAKEN TO PREVENT THE HAZARDS. 4. IN THE RESOURCES COLUMN, LIST THE EQUIPMENT AND RESOURCES THAT ARE NEEDED TO ACHIEVE THE "SAFE PLAN." 5. HAVE EACH TEAM MEMBER THAT HELPED DEVELOP THE JSA SIGN IN THE SPACES PROVIDED AT THE BOTTOM.						
DESCRIBE JOB OR TASK						
Prescribed burning to support the forestry/conservation burning programs.						
STEP	DESCRIBE INDIVIDUAL TASK STEPS	HAZARD	SAFE PLAN	EQUIPMENT & RESOURCES		
1	Develop an Arnold AFB Prescribed Burning Plan for each stand / site to be burned.	Failure to describe goals and equipment and resources required for the burn.	Develop plans and make available to all personnel assigned to each burn. Training of staff for burning procedures and safety.	Arnold AFB Prescribed Burning Plan for the particular stand/site to be burned which identifies all equipment and resources requirements for the particular burn.		
2	Establish fire control lines	Operator slips, trips, falls getting in/out of dozer. Other personnel slips, trips, falls resulting from rough terrain, vines, stumps, etc. in cleared fire control line.	Operator requests assistance getting in/out of dozer. All personnel become familiar with hazards on the site.	Additional personnel		
		Cuts resulting from use of chainsaw, hand tools	Prescribed Burning Plan available to all personnel assigned to each burn. Ensure that chainsaw operator has had at least 1-hour training session covering equipment safety, use and maintenance and has reviewed the National Safety Council pamphlet entitled "How To Improve Your Chainsaw Savvy".	See the Arnold AFB Prescribed Burning Plan for the particular stand/site on which assigned for equipment and resources that are required for this job. Adequate training.		
		Operator scraped, cut, crushed, pinched by tree limbs or debris entering the cab.	Warn operator of hazards of operating machine in field conditions.	Operator Instruction.		
3	Execute the burn and mop-up	ATV operator, scraped, cut, pinched by tree limbs, vines, etc. during ignition and mop-up	Wear DOT approved helmet when operating ATV. Make the Arnold AFB Prescribed Burning Plan available to all personnel assigned to the burn.	ATV operators must have ATV Safety Training and DOT approved helmet. Refer to the Arnold AFB Prescribed Burning Plan.		
		Cuts, burns resulting from felling or raking around burning snags.				
		Burns and/or eye injury resulting from blowing embers and smoke or blow-back from use of water pumper.				
		Burns resulting from flames when wind directions change.				

PROJECT NAME	LOCATION	WORK ORDER NO.
Prescribed Burning		

1. WRITE JOB/TASK IN THE SPACE PROVIDED AND DIVIDE THE TASK INTO INDIVIDUAL STEPS, AS APPROPRIATE.
2. IN THE HAZARD COLUMN, LIST ALL POSSIBLE HAZARDS ANTICIPATED IN THE INDIVIDUAL STEP OF THE TASK OR JOB
3. IN THE SAFE PLAN COLUMN, PROVIDE THE CORRECTIVE ACTIONS THAT WILL BE TAKEN TO PREVENT THE HAZARDS.
4. IN THE RESOURCES COLUMN, LIST THE EQUIPMENT AND RESOURCES THAT ARE NEEDED TO ACHIEVE THE "SAFE PLAN."
5. HAVE EACH TEAM MEMBER THAT HELPED DEVELOP THE JSA SIGN IN THE SPACES PROVIDED AT THE BOTTOM.

DESCRIBE JOB OR TASK

Prescribed burning to support the forestry/conservation burning programs.

STEP	DESCRIBE INDIVIDUAL TASK STEPS	HAZARD	SAFE PLAN	EQUIPMENT & RESOURCES
		Slips, trips, falls resulting from rough terrain, vines, stumps, etc. in cleared fire control line.		
4	Communication	Ability to communicate.	Ensure radios are on the job site at all times, with knowledge of emergency contacts.	Radios with charged batteries and extra batteries.
5	Environment	Snakes, spiders, bees, poison ivy, ticks (lyme disease)	Wear long pants and shirt, 8" leather boots, and insect repellent; have fresh wash water available. Avoid obvious exposure, check for ticks.	First aid kit, emergency contacts, insect repellent, fresh wash water, appropriate clothing, MSDS for insect repellent.

TASK TEAM MEMBERS

NAME PRINTED/SIGNATURE

NAME PRINTED/SIGNATURE

NAME PRINTED/SIGNATURE

SUPERVISOR(S)

NAME PRINTED/SIGNATURE

Appendix D

Prescribed Burn Plan

**ARNOLD AIR FORCE BASE
PRESCRIBED BURN PLAN**

DATE: _____ **STATE PERMIT NO.** _____

STAND NO.: _____ **COUNTY:** _____ **ACRES:** _____

PREVIOUS BURN DATE: _____ **FIRELINE TO ESTABLISH:** _____

SOURCES OF EMERGENCY ASSISTANCE

Base Fire Dept. Phone No. 911 or 454-4573 Base Security Phone No. 911 or 454-3418
Tennessee Forestry Division Phone No. 598-5535 or 728-3709

Nearest Phone to Stand: _____

Radio Contact: Base Fire Dept. Ch. 3 (Conservation Radio)
Base Operations Center Ch. 7 (Conservation Radio)

STAND DESCRIPTION:

Overstory Type & Size: _____ Tree Height: _____

Fuel Model(s): _____ Crown Ratio: _____

Estimated Fuel Load (tons/ac): _____

Purpose of the Burn: _____

FIRE BEHAVIOR:

	<u>Desired Range</u>	<u>Actual Range</u>
Rate of Spread (Ft./min.)	_____	_____
Fireline Intensity (Btu/Ft/Sec)	_____	_____
Flame Length (Ft.)	_____	_____
Scorch Height (Ft.)	_____	_____

WEATHER FACTORS:

	<u>Desired Range</u>	<u>Actual Range</u>
Air Temperature (Degrees F)	_____	_____
Relative Humidity (Percent)	_____	_____
Surface Winds (MPH)	_____	_____
Wind Direction	_____	_____
Mixing Height (Ft.)	_____	_____
Days Since Last Rain	_____	_____

FIRE MANAGEMENT NEEDS:

Manpower & Equipment Needs

Fire Line Preparation:

Prescribed Burn Operation & Mop-up:

Contingencies:

FIRE SAFETY GUIDELINES:

Safety Equipment: All personnel directly participating in the burn will wear at a minimum the following safety equipment:

- Nomex clothing (coveralls or long sleeve shirt and pants)
- Hardhat
- Leather gloves
- Leather lace-up boots – 8” height minimum
- Safety glasses or goggles

In addition, saw operators will wear ear and eye protection and protective (Kevlar) chaps during saw operation.

Prescribed Burn Training: All personnel involved with the burn will have at least the basic firefighter training provided by ACS Conservation using the “*Firefighters Guide*” published by the National Wildfire Coordinating Group. This training consists of classroom training (3 hours) and field exercises (5 hours). Classroom training covers fire weather, basic fire behavior, and individual responsibilities on the fire line including: 1) ignition techniques and procedures, 2) fire line construction guidelines, 3) mop-up procedures, 4) and fire line safety. Field exercises consists of actual fire line construction using hand tools, power equipment (chainsaw, blower, etc.) and controlling and mopping up a real or “mock” fire, given realistic weather and environmental parameters in terms of weather conditions, fire size, and specific elements of danger to be aware of and to consider. Safety is stressed during the field exercise by using all the appropriate safety equipment and procedures.

Safety: In addition to the above mentioned safety equipment and training, personnel working directly with power equipment (power saws, blowers, and pumper units) will

have had at least a 1 hour training session covering equipment safety, use, and maintenance. Also, a review of the pamphlet entitled "*How to Improve Your Chainsaw Savvy*" by the National Safety Council will be conducted annually.

ATV operators must have successfully completed the *ATV Rider Course* taught by an ATV Safety Institute certified instructor. All ATV operators will wear a properly fitted, Department of Transportation approved helmet, and safety glasses or goggles at all times. Each vehicle (truck, ATV, etc.) will be equipped with a properly charged fire extinguisher.

First Aid: Each fire crew will be equipped with a standard first aid kit and each crew member will know the location of said kit.

Communications: Each person participating in the burn will be equipped with a two-way radio, tuned in to the Forestry channel. Any variance from the Forestry channel must be first authorized by the assigned fire boss.

Safety Review: Before conducting the actual burn, the assigned fire boss of that fire will go over the prescribed burn plan with all personnel directly participating in the burn, check to ensure all personnel have and are wearing the minimum safety equipment, and that they have had the minimum prescribed burn training for their assigned responsibilities. Where appropriate and needed, lookouts, communications, potential escape routes, and safety zones will be established or identified by the assigned fire boss and communicated to all personnel directly participating in the burn.

SMOKE MANAGEMENT:

Smoke Sensitive Areas:

EVALUATION:

Burn Severity:

Prescribed by:

Approved by:

Name – Job Title
AEDC Conservation
Date

Name of Supervisor – Job Title
AEDC Conservation
Date

Attachments:

- Map of burn site
- Map of smoke sensitive areas
- Contingency map

Appendix E

Plant Associations Occurring on Arnold Air Force Base

Forest

Planted/Cultivated

Pinus taeda Planted Forest

Natural

Upland Forest

Quercus falcata - *Quercus coccinea* - *Quercus (stellata, velutina)* / *Vaccinium pallidum* Forest

Quercus falcata - *Quercus alba* - (*Quercus coccinea*) / *Oxydendrum arboreum* / *Vaccinium pallidum* Forest

Quercus alba - *Quercus (falcata, stellata)* / *Chasmanthium laxum* Forest

Juniperus virginiana var. *virginiana* - *Quercus spp.* Forest

Juniperus virginiana var. *virginiana* / *Rhus copallina* / *Schizachyrium scoparium* Forest

Wetland Forest

***Quercus lyrata* / *Betula nigra* / *Pleopeltis polypodioides* Forest**

Quercus phellos - *Quercus alba* / *Vaccinium fuscum* - (*Viburnum nudum*) / *Carex (barrattii, intumescens)* Forest

Liquidambar styraciflua Forest

Quercus phellos - *Quercus nigra* - (*Nyssa biflora*) Forest

Nyssa aquatica / *Cephalanthus occidentalis* Forest

Floodplain - Floodplain Terrace / Bottomland Forest

Quercus alba - *Carya (alba, ovata)* - *Liriodendron tulipifera* -(*Quercus phellos*) / *Cornus florida* Forest

***Quercus nigra* - *Quercus (alba, phellos)* Forest**

Liquidambar styraciflua - *Quercus michauxii* - *Carya laciniosa* / *Fagus grandifolia* -(*Aesculus flava*) Forest

***Quercus velutina* - *Carya (alba, glabra)* / *Vaccinium arboreum* Forest**

Platanus occidentalis - (*Liquidambar styraciflua*, *Acer rubrum*) / (*Carpinus caroliniana*) / *Onoclea sensibilis* Forest

Salix nigra - *Acer (rubrum, saccharinum)* / *Alnus serrulata* - *Cephalanthus occidentalis* Forest

Woodland

Quercus (falcata, stellata) / *Quercus marilandica* / *Gaylussacia (baccata, dumosa)* Woodland

Quercus stellata - (*Quercus coccinea*) / *Quercus marilandica* / *Vaccinium pallidum* - (*Vaccinium stamineum*) Woodland

SHRUBLAND

Upland shrubland

Rubus (argutus, trivialis) - Smilax (glauca, rotundifolia) Shrubland

Wetland shrubland

Cephaelanthus occidentalis - Hibiscus moscheutos ssp. moscheutos Shrubland

Herbaceous Vegetation

Upland Grassland

Andropogon gerardii - (Andropogon glomeratus, Panicum virgatum, Sorghastrum nutans)
Herbaceous Vegetation

Andropogon gerardii - Schizachyrium scoparium - (Calamagrostis coarctata, Panicum virgatum)
Herbaceous Vegetation

Schizachyrium scoparium - Andropogon (gyrans, ternarius, virginicus) Herbaceous Vegetation

Schizachyrium scoparium - Calamagrostis coarctata Herbaceous Vegetation

Andropogon virginicus var. virginicus Herbaceous Vegetation

Wetland Grassland

Juncus effusus Herbaceous Vegetation

Eleocharis microcarpa - Juncus repens - Rhynchospora corniculata - (Mecardonia acuminata - Proserpinaca spp) Herbaceous Vegetation

Panicum hemitomon - Dulichium arundinaceum Herbaceous Vegetation

Saccharum baldwinii - Calamagrostis coarctata - Panicum rigidulum - Rhynchospora capitellata
Herbaceous Vegetation

Scirpus cyperinus - Panicum rigidulum var. elongatum - Rhynchospora corniculata Herbaceous Vegetation

Typha latifolia Herbaceous Vegetation

Wetland Perennial Forb

Pontederia cordata - Sagittaria graminea - Sagittaria latifolia Herbaceous Vegetation

Source: Call, 2003

Appendix F

Sensitive Species Known to Occur on Arnold Air Force Base

Plants	Scientific Name	Common Name	Designated Status		Rank	
			Federal	Tennessee	Global	Tennessee
<i>Agalinis pseudophylla</i>		Shinner's false-foxglove	C2	E	G1G2Q	S1
<i>Carex barrattii</i>		Barratt's sedge		E	G4	S2
<i>Carex buxbaumii</i>		Brown bog sedge		S	G5	S1
<i>Clethra alnifolia</i>		Coastal sweet pepper-bush		T	G5	S1
<i>Cypripedium acaule</i>		Pink lady's-slipper		E-CE	G5	S4
<i>Cypripedium kentuckiense</i>		Kentucky lady's-slipper	C2	E	G3	S1
<i>Panicum aciculare</i>		Needleleaf witchgrass		E	G4G5	S1
<i>Panicum ensifolium</i>		Small-leaved panic grass		S	G4	S1S2
<i>Panicum acuminatum leucothrix</i>		Roughish witchgrass		S	G4?Q	S1
<i>Drosera brevifolia</i>		Dwarf sundew		T	G5	S2
<i>Echinacea pallida</i>		Pale-purple coneflower		T	G4	S1
<i>Eleocharis intermedia</i>		Matted spike-rush		S	G5	S1
<i>Eupatorium leucolepis</i>		White-bracted thoroughwort		E	G5	S1
<i>Festuca paradoxa</i>		Cluster fescue		S	G5	S1
<i>Gaylussacia dumosa</i>		Dwarf huckleberry		T	G5	S3
<i>Gentiana puberulenta</i>		Prairie gentian		E	G4G5	S1
<i>Gymnopogon brevifolius</i>		Broad-leaved beardgrass		S	G5	S1S2
<i>Helianthemum propinquum</i>		Low frostweed		S	G4	S1
<i>Helianthus eggertii</i>		Eggert's sunflower	T	T	G3	S3
<i>Hypericum adpressum</i>		Creeping St. John's-wort	C2	T-PE	G2G3	S1
<i>Iris prismatica</i>		Slender blue flag		T	G4G5	S2S3
<i>Isoetes melanopoda</i>		Blackfoot quillwort		E	G5	
<i>Juglans cinerea</i>		White walnut, butternut		T	G3G4	
<i>Lachnanthes caroliniana</i>		Carolina redroot		E	G4	

Plants	Scientific Name	Common Name	Designated Status		Rank	
			Federal	Tennessee	Global	Tennessee
<i>Lechea pulchella</i>	Legget's pinweed		E	G5		
<i>Lespedeza angustifolia</i>	Narrowleaf bushclover		T	G5		
<i>Lilium michiganense</i>	Michigan lily		T	G5		
<i>Liparis loeselii</i>	Fen orchis		E-PT	G5	S1	
<i>Listera australis</i>	Southern twayblade		E	G4	S1S2	
<i>Lobelia canbyi</i>	Canby's lobelia		T	G4	S2S3	
<i>Ludwigia sphaerocarpa</i>	Globe fruited false loosestrife		T	G5	S2	
<i>Lycopodiella alopecuroides</i>	Foxtail clubmoss		T	G5	S1	
<i>Marshallia trinervia</i>	Broad-leaved Barbara's buttons		T	G3	S2	
<i>Muhlenbergia glabriflora</i>	Hair grass		E	G4?	S1	
<i>Muhlenbergia torreyana</i>	Torrey's dropseed		S	G3	S1	
<i>Myriophyllum pinnatum</i>	Cutleaf water-milfoil		T	G5	S1	
<i>Panicum acuminatum</i> var. <i>densiflorum</i>	Eaton's witchgrass		E	G5	S1	
<i>Panicum hemitomon</i>	Maidencane		S	G5?	S2	
<i>Platanthera integra</i>	Yellow fringeless orchid		E	G3G4	S2S	
<i>Pogonia ophioglossoides</i>	Rose pogonia		E	G5	S2	
<i>Polygala mariana</i>	Maryland milkwort		S	G5	S1	
<i>Polygala nuttallii</i>	Nuttall's milkwort		E	G5	S1	
<i>Prenanthes aspera</i>	Harsh rattlesnake-root		E	G4?	S1	
<i>Prunus pumila</i>	Sand cherry		T	G5	S1	
<i>Ranunculus flabellaris</i>	Yellow water crowfoot		T	G5	S2	
<i>Rhyncospora perplexa</i>	Obscure beak-rush		T	G5	S2	
<i>Sagittaria graminea</i>	Grass-leaved arrow head		T	G5	S1	
<i>Trillium pusillum</i> var. <i>pusillum</i>	Least trillium	C2	E	G3T2	S1S2	
<i>Utricularia subulata</i>	Zigzag bladderwort		T	G5	S1	

Plants		Designated Status		Rank	
		Federal	Tennessee	Global	Tennessee
<i>Vaccinium ellottii</i>	Mayberry		E	G5Q	S1
<i>Vaccinium macrocarpon</i>	Large cranberry		T	G4	S2
<i>Woodwardia virginica</i>	Virginia chainfern		S	G5	S2
<i>Xyris fimbriata</i>	Fringed Yellow-eyed-grass		E	G5	S1
<i>Xyris laxifolia</i> var. <i>iridifolia</i>	Wide-leaved yellow-eyed-grass		S	G4G5T4T5	S2
<i>Zigadenus leimanthoides</i>	• Death camass		T	G4Q	S2

Status refers to the legal protection afforded the species.

C2 indicates a species formerly classified as a federal candidate species.

T = Threatened, E = Endangered, S = Special Concern, PT = Proposed Threatened, PE = Proposed Endangered, CE = commercially exploited

Rank is an indication of global and state rarity ranging from 1 (most rare) to 5 (most common)

? = inexact numeric rank

Q = taxonomic status is questionable, numeric rank may change with taxonomy

T = taxonomic subdivision (trinomial)

Source: Call, 2003 and TDEC Natural Heritage Website, 2004b.

Animals	Scientific Name	Common Name	Designated Status		Rank	
			Federal	Tennessee	Global	Tennessee
<i>Accipiter striatus</i>	Sharp-shinned Hawk		D	G5	S2	
<i>Aimophila aestivalis</i>	Bachman's Sparrow		E	G3	S2	
<i>Ambystoma talpoideum</i>	Mole Salamander		D	G5	S4	
<i>Ammodramus henslowii</i>	Henslow's Sparrow		C	G4	SPB	
<i>Ammodramus savannarum</i>	Grasshopper Sparrow		D	G5	S4	
<i>Circus cyaneus</i>	Northern Harrier		D	G5T?	S1N	
<i>Haliaeetus leucocephalus</i>	Bald Eagle		T	G4	S1	
<i>Hemidactylum scutatum</i>	Four-toed Salamander		D	G5	S3	
<i>Hemitremia flammea</i>	Flame Chub		D	G4	S4	
<i>Hyla gratiosa</i>	Barking Tree Frog		D	G5	S3	
<i>Myotis griseescens</i>	Gray Bat		E	E	G2G3	S2
<i>Myotis sodalis*</i>	Indiana Bat		E	E	G1	S1
<i>Napaeozapus insignis</i>	Woodland Jumping Mouse		D	G5	S4	
<i>Ophisaurus attenuatus</i>	Eastern Slender Glass Lizard		D	G5T5	S3	
<i>Pituophis melanoleucus</i> <i>melanoleucus</i>	Northern Pine Snake		T	G5T4	S3	
<i>Pleurobema gibberum</i>	Cumberland Pigtoe		E	E	G1	S1
<i>Rana capito</i>	Gopher Frog		C1NL	?	G4T3	S1
<i>Sorex cinereus</i>	Masked Shrew			D	G5	S4
<i>Sorex fumeus</i>	Smoky Shrew			D	G5	S4
<i>Sorex longirostris</i>	Southeastern Shrew			D	G5	S4
<i>Zapus hudsonius</i>	Meadow Jumping Mouse			D	G5	S4

C2 and C1NL indicate species formerly classified as a federal candidate species.

T = Threatened, E = Endangered, D =Deemed in Need of Management

Rank is an indication of global and state rarity ranging from 1 (most rare) to 5 (most common)

* = possible occurrence

Source: Call, 2003; TDEC Natural Heritage Website, 2004c; TDEC Natural Heritage Website, 2004d.

Appendix G

Conservation Target Species Occurring in Wetlands on Arnold Air Force Base

Conservation Target Species Occurring in Wetland Flats

Carex barrattii (Barratt's sedge)
Iris prismatica (Slender blue flag)
Listera australis (Southern twayblade)
Lycopodiella alopecuroides (Foxtail clubmoss)
Muhlenbergia torreyana (Torrey's dropseed)
Platanthera flava var. *flava* (Southern rein-orchid)
Trillium pusillum var. *pusillum* (Least trillium)
Vaccinium macrocarpon (Cranberry)
Zigadenus leimanthoides (Death camas)

Conservation Target Species Occurring in Wetland Depressions

Ambystoma talpoideum (Mole salamander)
Hemidactylum scutatum (Four-toed salamander)
Rana capito (Gopher frog)
Clethra alnifolia (Coastal sweet pepperbush)
Hypericum adpressum (Creeping St. John's-wort)
Lachnanthes caroliniana (Carolina redroot)
Ludwigia sphaerocarpa (Globe-fruited false loosestrife)
Panicum aciculare (Needleleaf witchgrass)
P. acuminatum var. *densiflorum* (Eaton's witchgrass)
P. acuminatum var. *leucothrix* (Roughish witchgrass)
P. ensifolium (Small-leaved panicgrass)
P. hemitomon (Maidencane)
Rhynchospora perplexa (Obscure beakrush)
Sagittaria graminea (Grass-leaved arrowhead)
Vaccinium elliottii (Mayberry)
Woodwardia virginica (Virginia chainfern)
Xyris fimbriata (Fringed yellow-eyed-grass)
X. iridifolia (Wide-leaved yellow-eyed-grass)

Source: Call, 2003 and TDEC Natural Heritage Website, 2004a.

Appendix H

Conservation Target Species Occurring in Woodland/Savanna/Grassland Habitats on Arnold Air Force Base

Species Occurring on Dry Sites:

Circus cyaneus (Northern harrier)
Ophisaurus attenuatus (Eastern slender glass lizard)
Agalinis pseudophylla (Shinner's false-foxglove)
Echinacea pallida (Pale purple coneflower)
Festuca paradoxa (Slender fescue)
Gentiana puberulenta (Prairie gentian)
Gymnopogon brevifolius (Broad-leaved beardgrass)
Helianthemum propinquum (Low frostweed)
Helianthus eggertii (Eggert's sunflower)
Lechea pulchella (Leggett's pinweed)
Lespedeza angustifolia (Narrowleaf bushclover)
Prenanthes aspera (Harsh rattlesnake-root)

Species Occurring on Mesic Sites:

Asclepias hirtella (Prairie milkweed)
Eupatorium leucolepis (White-bracted thoroughwort)
Polygala nuttallii (Nuttall's milkwort)
Pogonia ophioglossoides (Rose pogonia)
Prunus pumila (Sand cherry)
Platanthera integra (Yellow fringeless orchid)

Source: Call, 2003 and TDEC Natural Heritage Website, 2004a.